PRJEVALSKY'S HORSE

BY
W. SALENSKY

TRANSLATED BY CAPTAIN M. H. HAYES
WITH
INTRODUCTION BY PROFESSOR J. COSSAR EWART

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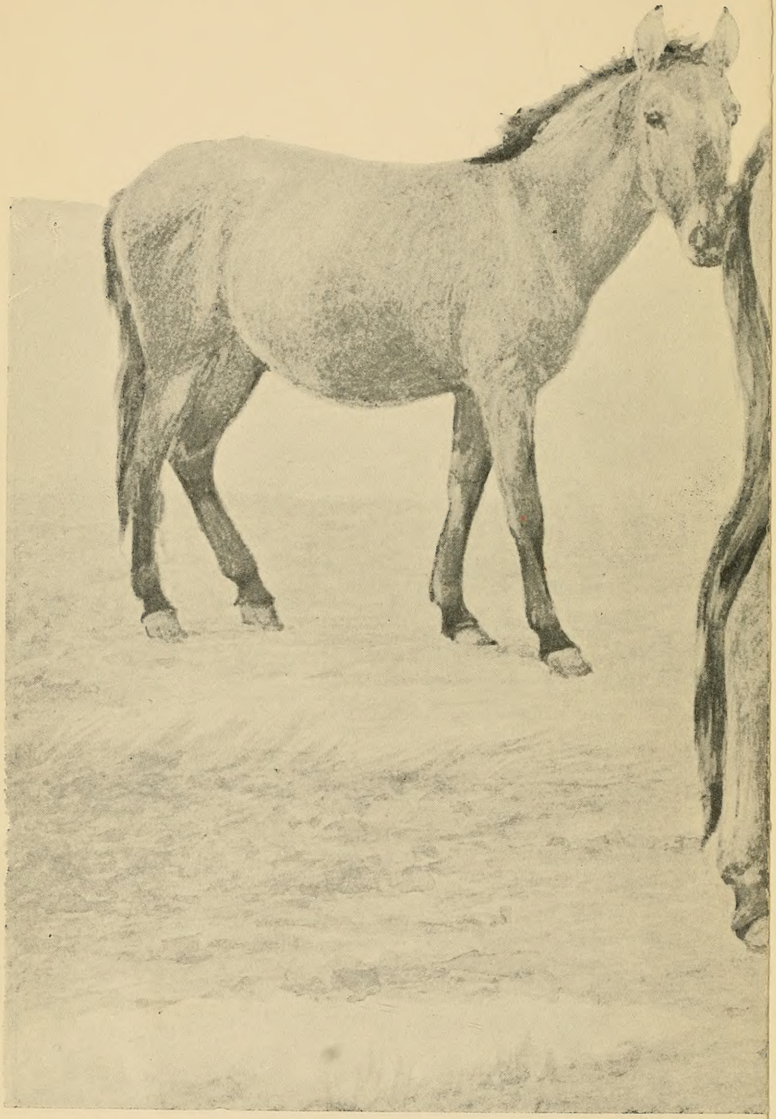

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PRJEVALSKY'S HORSE

(Equus Prjewalskii Pol.)

BY

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St. Petersburg

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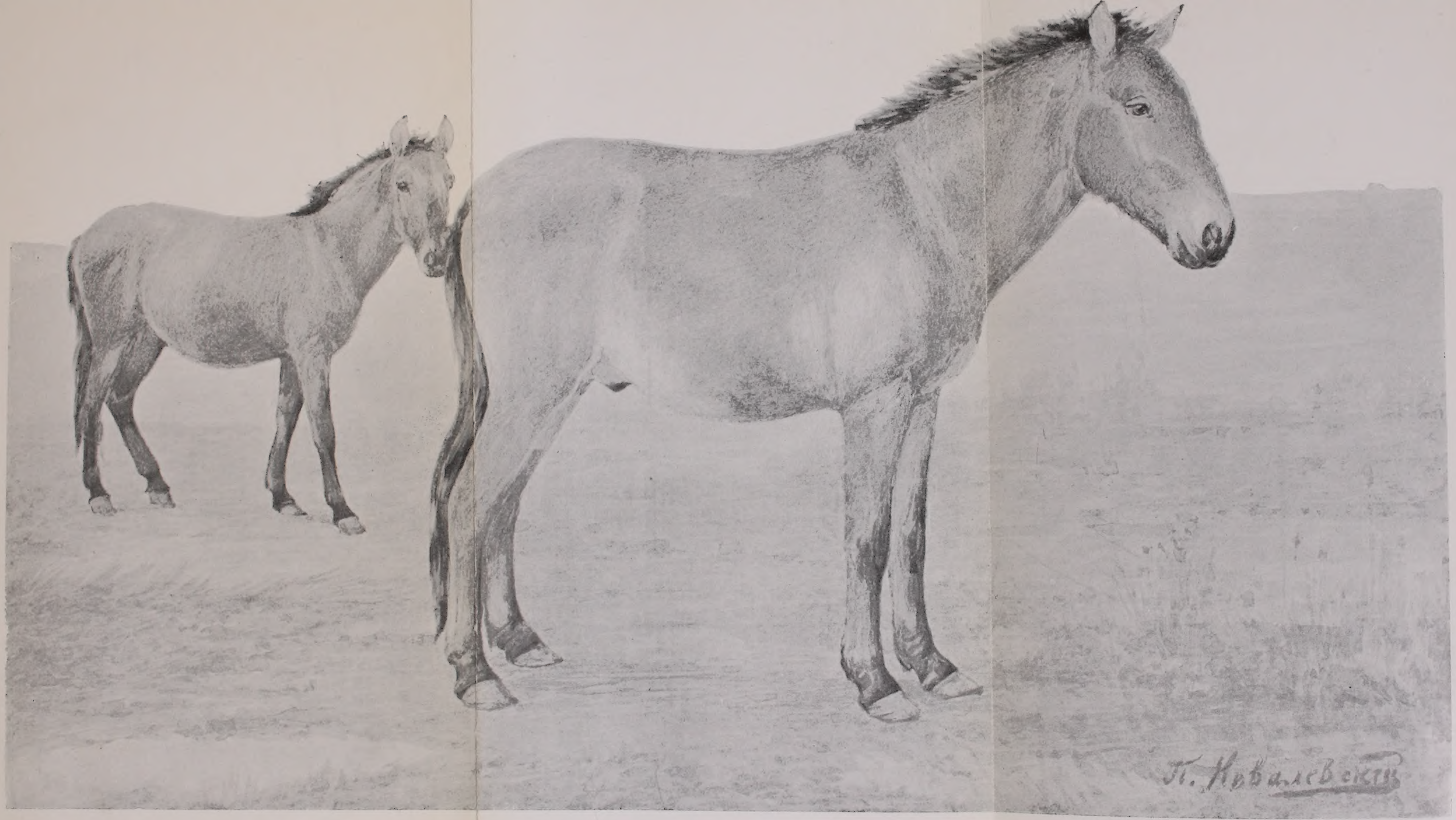

Fig. 1.—*Equus Prjevalskii Poljak.*

[*Frontispiece.*

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LIST OF ILLUSTRATIONS.

INTRODUCTION.

FIG. PAGE

1. Young Prjevalsky horses viii
2. Young Prjevalsky mare ix
3. Two year-old Prjevalsky horse xi
4. A Highland pony of the forest type xii
5. An Iceland pony of the Celtic type xiii
6. A yearling Prjevalsky stallion xv

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1. *Equus Prjevalskii Poljak* . . . . *Frontispiece*
2. Measurements of parts of the body of *Equus Prjevalskii* . 7
3. Prjevalsky horses in the possession of F. A. Falz-Fein, among them a bastard zebra 9
4. *Equus Prjevalskii.* Stuffed specimen 13
5. ,, ,, ,, ,, ... 14
6. Skull of *Equus Prjevalskii* . . . *Facing page* 23
7. Skull of *Equus asinus* . . . . ,, ,, 24
8. Mandible of *Equus Prjevalskii* 35
9. Mandible of the ass (*Equus asinus*) 36
10. Series of upper cheek teeth . . . *Facing page* 40
11. Atlas (ventral aspect) 43
12. Atlas (dorsal aspect) 44
13. Axis (lateral aspect) 44
14. Sixth cervical vertebra (lateral aspect) 45
15. First thoracic vertebra (lateral aspect) 46
16. Eighteenth thoracic vertebra (lateral aspect) . . . 47
17. Lumbar vertebra (caudal aspect) 47
18. Sacrum (dorsal aspect) 48
19. Scapula (lateral aspect) 49
20. Humerus 50
21. Radius and ulna 52
22. Innominate bones . . . . . *Facing page* 53
23. Femur 54

INTRODUCTION.

In prehistoric times wild horses seem to have been as abundant in the south of Europe as are zebras to-day in East Africa. This being the case it is not surprising that all through the historic period it has been assumed by travellers, if not by naturalists, that wild horses still survived. It must be confessed that during the greater part of the nineteenth century believers in the existence of true wild horses could only point to the tarpan of the Russian steppes—a form now known to be a blend of several varieties. But some thirty years ago, when few ever expected to see a genuine true wild horse—a horse with an unbroken line of wild ancestors—it was reported that the Russian traveller Prjevalsky had discovered a new and quite distinct type of horse in the Great Gobi Desert to the west of Mongolia.

In 1881 an account of this wild horse, under the name *Equus Prjevalskii*, was published by Poliakof, and some years later new facts were added to the original description by the brothers Grum-Grjimailo, and more important still, in 1902 a herd of about thirty young Prjevalsky horses reached Europe. Up to the arrival of the living specimens in 1902, English naturalists, with few exceptions, were not prepared to regard Prjevalsky's horse as a valid species. Some said it was a kiang hybrid; others that it was the off-spring of escaped Mongol ponies. The young horses which reached England from Mongolia in 1902 did little to reassure those naturalists who were not yet convinced that Prjevalsky's horse formed a good species. On their arrival, being immature and out of condition, the young colts looked ungainly and lifeless, the large head looked out of proportion to the undeveloped trunk, the coat was ragged, the gait awkward, the mane arched to one side as in hybrids, and the tail suggested a mule more than a horse. It was hence not wonderful that the Prjevalsky colts failed to realize one's conception of a wild horse. It had long been assumed that the wild ancestor of domestic horses, if ever found, would be at least as richly striped as Norwegian and Highland ponies. In this respect also the new species was disappointing; a dorsal band was present, but there were at the most only the merest vestiges of stripes on the shoulders and legs. This made it all the more difficult to decide what position the wild Mongolian horse should occupy in the Equidæ family.

When sufficient material was available Dr. W. Salensky, of the Zoological Museums of the Imperial Academy of Sciences, St. Petersburg, set about finding out how this new horse was related to the other Equidæ. By studying the external characters, teeth and skeleton, he eventually arrived at the conclusion "that *E. Prjevalskii* is a separate form—species or race—of the genus *Equus;* equivalent to the other species or races, such as the kiang, the onager, the ass, etc.," and that it "is of extraordinary interest, since, in it, the characters of the domestic horse (presence of callosities on all four limbs) are mixed with features reminding one of the Asiatic ass."

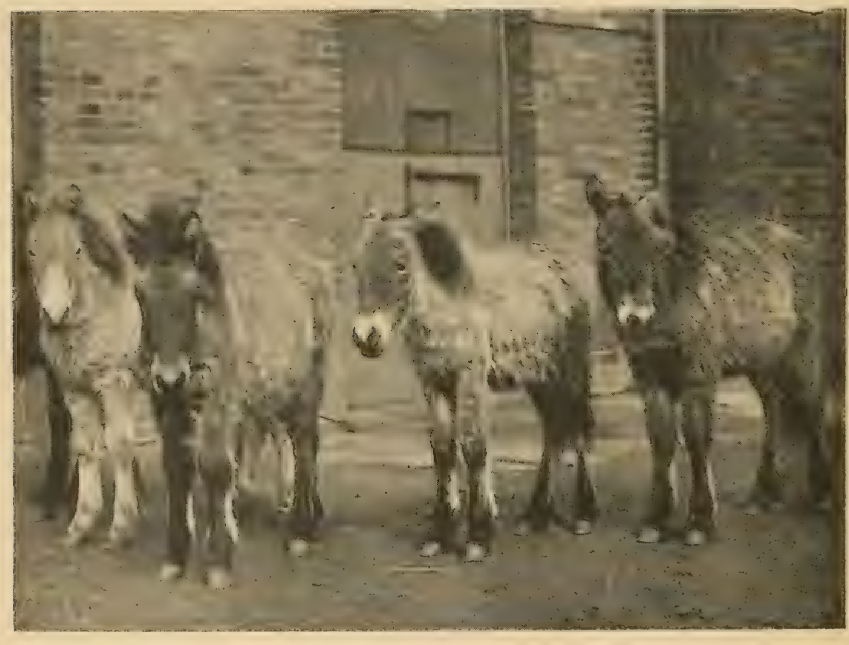

Photo by] [W. P. Dando.

Fig. 1.—Young Prjevalsky horses on their arrival from Mongolia. (From Hayes' "Points of the Horse.")

Dr. Salensky realized the importance of determining what relationship existed between the wild horse of Mongolia and domestic horses, more especially whether it had " given origin to any of the ancestors of the domestic horse," but for want of data he was not in a position to deal exhaustively with these problems.

Since 1902 the young horses imported from Mongolia have reached maturity, and while I have demonstrated that they decidedly differ from mules obtained by crossing a wild Asiatic ass with Mongolian, Exmoor and other ponies, it has been proved, in the Duke of Bedford's herd of wild horses at Woburn, that, unlike zebra and ass mules, they are not only fertile with each other, but, in addition, produce hybrids when crossed with domestic mares.

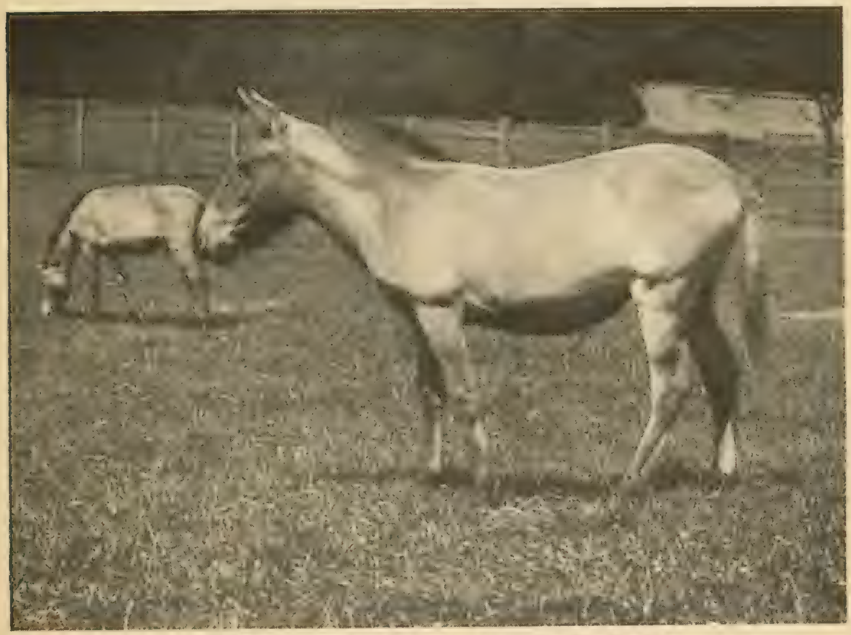

Photo by] [THE DUCHESS OF BEDFORD.

Fig. 2.—Young Prjevalsky mare in summer coat.
(From Hayes' "Points of the Horse.")

Since Dr. Salensky's work on Prjevalsky's horse was published in 1902, evidence has been accumulating in support of the view that domestic horses have had a multiple origin, i.e., that several distinct kinds or species of wild horses were domesticated in prehistoric times and their off-spring afterwards blended to form the present numerous more or less distinct breeds. Further, there are now good grounds for believing that one of the wild species domesticated in prehistoric times was identical with, or closely related to, the wild horse (*E. Prjevalskii*), still surviving in the Dzungaria and Kobdo districts of the Great Gobi Desert of Mongolia.

If Prjevalsky's horse has played an important part in forming some of our more important domestic breeds, has contributed characters to the English Shire horse, and had something to do with the making of Barbs and Turks and other forms which helped materially to produce the English racehorse, it may be presumed that not a few of the many thousands in England interested in the history and origin of domestic horses will welcome a translation of a work which deals with the most interesting living member of the horse family.

But as Salensky's work must be read in the light of recent discoveries and speculations, it may be as well in this introduction to state shortly the conclusions recently arrived at as to the origin of the horses now living under domestication.

There are now several distinct species of zebras living in Africa; in like manner in prehistoric times there were several distinct species of horses living in Europe, Asia, and North Africa. In Europe horses, like deer and other ungulates, were originally hunted for food, but by and by the men of the Stone Age set about their domestication. How many kinds or species of horses were domesticated in the Northern Hemisphere will probably never be known. Darwin, with some misgivings, arrived at the conclusion that domestic breeds had all come from a single wild species "of a dun-colour and more or less striped." Hamilton Smith thought domestic horses had been derived from five species or *stirpes* of the following colours, viz.:—dun, bay, grey, black and piebald. Prof. Pietrement, the distinguished French authority, tells us horses were domesticated in eight separate areas—two in Asia and six in Europe—the eight races in these more or less isolated areas forming, however, only one species. Prof. Ridgeway, in his work, the "Origin and Influence of the Thoroughbred Horse,"* says all the improved breeds of the world were formed by the blending of a fine bay horse (*E. c. libycus*), evolved in North Africa, with a coarse variety (allied to Prjevalsky's horse) of a white or dun colour, which originally had its home in Upper Europe and Upper Asia.

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* Cambridge University Press, 1905.

Some years ago I came to the conclusion that the domestic horses of Europe, North Africa and the greater part of Asia had mainly been derived from three wild species or varieties, which in a recent paper I have named the Steppe, Forest, and Plateau varieties. This conclusion, based on a study of the skeleton as well as of the external characters and habits of modern horses, has been confirmed by the examination of a number of skeletons of horses in the possession of the Romans or their auxiliaries who garrisoned the Newstead Fort, near Melrose, during the first and second centuries, A.D.

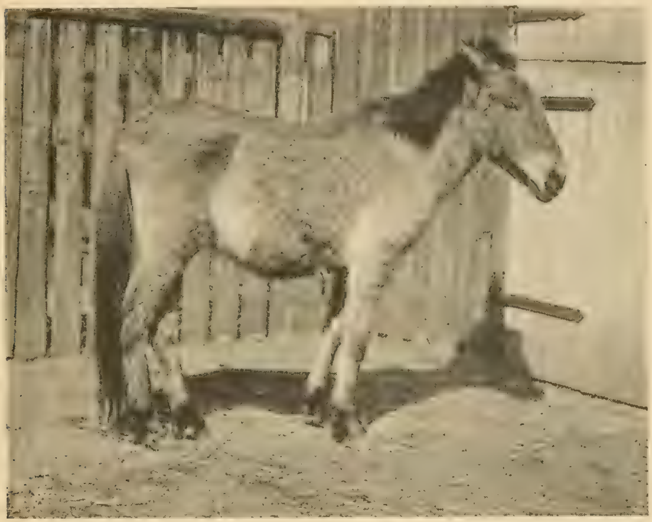

Photo by] [G. A. EWART.

Fig. 3.—Two year-old Prjevalsky horse in winter coat. Note the coarse ram-like head and the wide space between the eye and the nostril, as in many cart horses.

(From Hayes' "Points of the Horse.")

The Steppe variety, of which Prjevalsky's horse is a wild representative, includes forms in which the face is long and strongly bent on the cranium, as in the preglacial American horse *E. scotti*, and as in sheep and oxen and other forms specially adapted for cropping short herbage.

The Forest variety, of which semi-wild repesentatives occur in Iceland and certain other outlying areas, includes forms in which the face is short and broad and nearly in a line with the cranium as in the elk of Norway, the okapi of Tropical Africa and the very primitive three-toed Miocene horse (*Hypohippus*), which like the elk and okapi was a forest form, adapted for browsing on trees, shrubs and tall grasses.

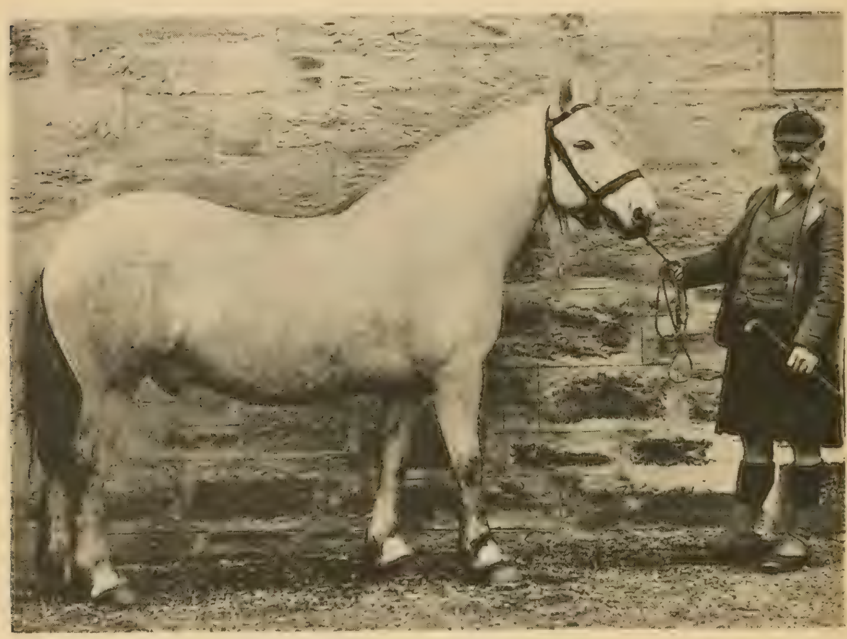

Photo by] [M. H. H.

Fig. 4.—A Highland pony, with the short neck, long body, round quarters, tied-in elbows, short legs and broad hoofs of the forest variety.

(From Hayes' "Points of the Horse.")

The Plateau variety includes slender-limbed forms (originally adapted for a free life on open plains) without ergots and hind chestnuts. This variety, especially characterized by a narrow face and a long neck, is represented by horses occasionally met with on the Mexican plateaus, by the Celtic pony of North-Western Europe, and the somewhat specialized forms included in Prof. Ridgeway's variety (*E. c. libycus*).

Members of these three varieties differ in many respects. In the Steppe variety the outline of the face is convex, i.e., there is a ram-headed or "Roman-nosed" condition; in the Forest variety the face is concave (dished) for some distance below the eye, but arched near the muzzle so as to form an elk-like nose and upper lip; in the Plateau variety the outline of the face is slightly concave or nearly straight, and thus we have a flat-nosed condition.

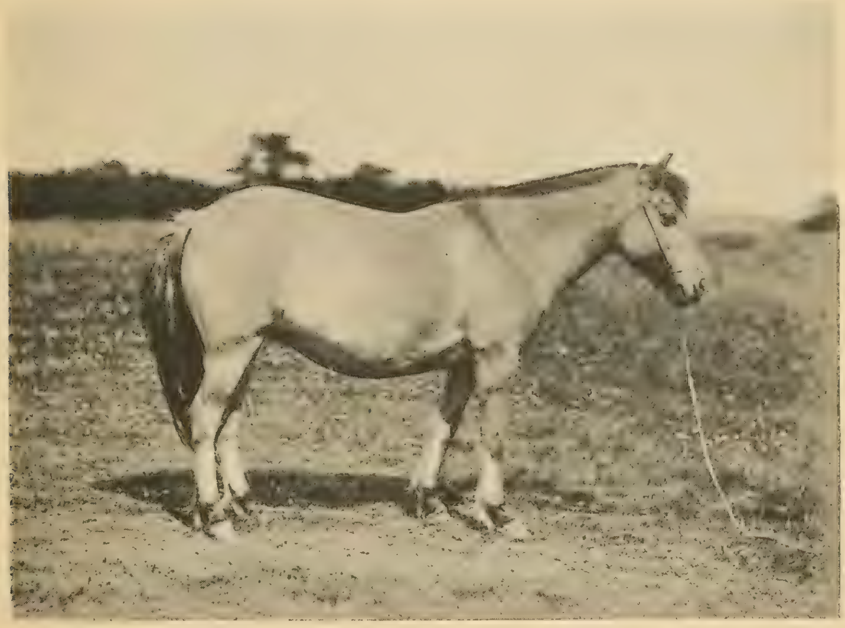

Photo by] [M. H. H.

Fig. 5.—Prof. Ewart's most typical yellow-dun pony of the Celtic type in summer coat, with the mane removed. In winter there is a bunch of hair (taillock) at the root of the tail. The head is narrow, the ears small, and the eyes large and prominent. All the ergots, as well as the hind chestnuts, are absent.

(From Hayes' "Points of the Horse.")

In the Steppe horse the eyes, lateral in position, are far from the nostrils, but relatively near the decidedly long ears; in the Forest horse the eyes may be so prominent that the wide space between them (the brow) is concave; further, the eyes being nearly midway between the top of the head and the nostrils, are relatively far from the ears, which are broad and wider apart than in the Steppe type. In the Plateau horse the ears are small and near each other, the eyes are large, full and prominent, but not so far down the face as in the Forest variety. In Steppe and Forest horses the neck and chest are short; in the Plateau variety (owing to the greater length of the cervical vertebræ and of the vertebræ carrying the first nine pairs of ribs) the neck and chest are long. In the Steppe and Plateau variety there are five lumbar vertebræ and a well set-on tail; in the Forest variety six lumbar vertebræ, rounded hind quarters, and a low set-on tail—in the Celtic pony there is a large taillock, the tail hence differs greatly from the mule-like tail of Prjevalsky's horse. In the limbs one notices differences in the hoofs as well as in the number of callosities and in the form of the metacarpal bone, i.e., of the long bone below the knee which attracts so much attention from breeders. In the Forest horse the hoof is broad and wide at the heels; in Prjevalsky's horse the hoof is long, narrow and contracted at the heels; in the Plateau horse the hoof—always small—varies with the habitat, being sometimes wide, sometimes narrow. The metacarpal (shank) bone in the Forest horse is so broad from side to side that the length may be only 5.4 times the width at the centre of the shaft—hence in the Forest horse the " bone " is round. In the Steppe and Plateau varieties the metacarpals are long and narrow, with the result that the length may be 7.5 times the width—hence in these types the " bone " is flat. The Forest and Steppe horses have eight callosities (four ergots and four chestnuts); in the Plateau horses, as already mentioned, the only callosities are the two front chestnuts. The three varieties also differ in their colours; the Steppe and Plateau forms are of a yellow or reddish dun tint with more or less dark points, but beyond a narrow dorsal band, there are only the merest vestiges of stripes. The Forest variety is of a dark yellow dun colour with dark points, a very broad dorsal band, and in typical cases, stripes on the face, neck and trunk and above and below the knees and hocks.

The importance of realizing the existence of a Forest and a Plateau variety as well as of a Steppe (or Prjevalsky) variety becomes evident when we proceed to study the modern domestic breeds. I need only give one or two examples of this. If, as I have indicated, domestic horses have sprung from several wild varieties adapted for different habitats—one like the extinct horse (*Hypohippus*) adapted for a forest life, one like the Miocene horse (*Neohipparion*) for a life on boundless plains, and one like Prjevalsky's horse for a steppe life—they should differ in their skulls, teeth and limbs, and by measuring the skull and limb bones it should be possible to estimate from which wild varieties they have inherited their chief characteristics.

When measurements of the skull of a Shire horse (of e.g. the skull of "Starlight" preserved in the British Museum) are compared with measurements of Steppe, Forest and Plateau skulls, it is at once obvious that in its skull a Shire horse may very closely agree with Prjevalsky's horse. When, however, the limbs of a Shire horse are studied it is seen that they are constructed on the lines of the Forest type. Hence it may be inferred that Shires are mainly a blend of the Steppe and Forest varieties, i.e., that they have in part sprung from ancestors allied to, if not identical, with Prjevalsky's horse. An examination of the skull of an Arab (of e.g. "Jerboa" in the British Museum) may show that it is nearly identical with the skull of a typical Plateau horse. When, however, measurements are made of the skeleton of the thoroughbred "Stockwell" (also in the British Museum) it is found that, while in his skull "Stockwell" agrees closely with Prjevalsky's horse and differs from the Arab "Jerboa," he has limbs of the Plateau type.

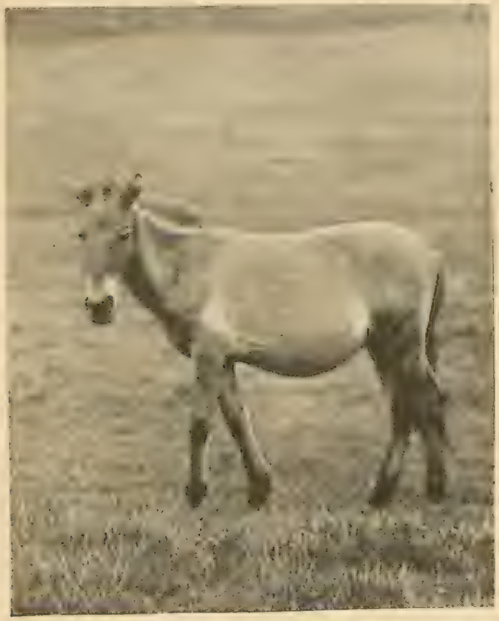

Photo by] [M. H. H.

Fig. 6.—A yearling Prjevalsky stallion in summer coat. Note the long ears, very long face, slender limbs, and absence of a forelock. (From Hayes' "Points of the Horse.")

Evidence of this we especially have in the metacarpals being so long and narrow that the length is 7.3 times the width at the centre of the shaft instead of 5.4 in horses with limbs of the Forest type.

If I am right in assuming domestic horses are a blend of two or more varieties, carefully conducted crossing experiments ought to show (1) That all horses with a long face, i.e., a long interval between the eyes and the nostrils, or with a prominence extending above and below the level of the eyes, or with a "Roman-nose," or with long ears and a mule-like tail, or with narrow hoofs contracted at the heels, have in part sprung from Prjevalsky-like (Steppe) ancestors. (2) That all horses with a broad short dished face and an elk-like nose, or with a long body, round quarters and a low set-on tail, or with short legs tied-in at the elbows and ending in broad hoofs, or a broad dorsal band and bars on the legs, include Forest types among their ancestors. (3) That horses with small ears and large eyes, a small, narrow face ending in a fine muzzle, or with a long neck and oblique shoulders, or with the ergots and hind chestnuts absent or very small, or with a bunch of hair (taillock) at the root of the tail, will include Plateau forms amongst their ancestors.

If as I have indicated a horse of the Prjevalsky or Steppe type has played an important part in the making of Shires, thoroughbreds and other important breeds, it will be evident that our interest in the wild horses still living in the Great Gobi Desert is certain to increase.

In conclusion I ought to explain that the consent of Dr. Salensky, and of the Imperial Academy of Sciences, St. Petersburg, having been obtained, the late Capt. M. H. Hayes undertook to prepare a translation (from the German text) of Dr. Salensky's book on Prjevalsky's horse. As it happened Captain Hayes was so fully occupied with a new edition of his standard work on the "Points of the Horse," that at the date of his lamented and untimely death the translation was still unfinished. Having learned that Captain Hayes, who devoted so much of his life to studying the Equidæ and left to the world an unrivalled series of works on the horse, was anxious that a translation of Dr. Salensky's work should be published in England I appealed to Professor O. Charnock Bradley, D.Sc., who fortunately took the matter in hand, with the result that English readers have now the opportunity of making themselves familiar with Dr. Salensky's views as to the structure, distribution and relationships of a horse, which I have no hesitation in saying will, as the years roll on, attract more and more the attention of all interested in domestic as well as in wild horses.

J. C. Ewart.

THE PRJEVALSKY HORSE.

(Equus Prjevalskii).

In the year 1881, I. S. Poliakof founded the species, *Equus prjevalskii*, upon the characters revealed by the examination of the skin and skull of a single specimen which had been presented to the Zoological Museum, St. Petersburg, by N. M. Prjevalsky. Poliakof was of opinion that the animal from which the material has been obtained was three years old at the time of death; but we are compelled to regard it as having been considerably younger if the age be judged by the condition of the teeth, as would be done in the case of the domestic horse. Moreover, seeing that the skin carries the winter coat, it cannot be taken as showing the typical external characteristics of the species; and, consequently, it can be easily understood that some of the features described by Poliakof as specific have been proved not to have this value; with the result that alterations have been found necessary in the list of specific characters as given by him. Thanks to numerous expeditions into Mongolia, the collection of material representing *Equus prjevalskii* is now considerable. The Zoological Museum of the Imperial Academy of Science now possesses thirteen skins, nine skulls of different ages, and an incomplete skeleton. A stuffed specimen is in the Zoological Museum of the University of Moscow, and another is in the Museum at Paris (Jardin des Plantes). Recently, living Prjevalsky horses have been imported into Russia.

F. A. Falz-Fein, as the fruit of assiduous toil, was the first to succeed in obtaining living specimens. Three of his five young thorough-bred mares are still living, as well as two half-bred mares captured by him in 1898. A description of these, with illustrations, will be given later in this communication. In the spring of 1901, Prince A. A. Oochtomsky obtained two young specimens, a mare and a stallion, which he presented, in the same year, to His Majesty the Czar, and which are now in the Imperial stables at Tsarskoe-Selo. The Zoological Garden of Moscow also obtained two young males in 1901, and a mare later.

As I have determined to give a new description of *E. prjevalskii*, it is not necessary that I should limit myself to the consideration of the single specimen captured by N. M. Prjevalsky, especially seeing that I can extend my investigations by the examination of the material accumulated, as the result of further expeditions, in the Zoological Museum of the Imperial Academy of Science. I have also been able to examine those living representatives of this interesting equine species which are in the Imperial stables at Tsarskoe-Selo.*

The material in the Zoological Museum consists of the following:

(1). A young animal, from 18 to 20 months old, killed in the Steppes of East Dzungaria by Kirgiz hunters, and sent by Tichonov to N. M. Prjevalsky, who presented it to the Zoological Museum. (Skin, No. 1,523; skull, No. 514). This is the specimen upon which the first description of *E. prjevalskii* was based.

(2). An adult stallion, obtained by G. and M. Grum-Grjimailo from Goschan. (Skin, No. 3,092; skull, No. 5,214.) Belonging thereto is a skeleton (skull, vertebral column, and the bones of the left limbs).

(3). A female foal obtained by G. and M. Grum-Grjimailo, in Goschan. (Skin, No. 3,093; skull, No. 5,217.)

(4). Stallion obtained by G. and M. Grum-Grjimailo, in Goschan. (Skin, No. 3,074; skull, No. 5,216.)

(5). A young animal obtained by G. and M. Grum-Grjimailo, in Goschan. (Skin, No. 3,091.)

(6). An adult mare obtained by the Consul Schischmareff, in the district of Kobdo, West Mongolia. This was sent to the Museum labelled "Onager." (Skin, No. 3,090; skull, No. 5,213.)

(7). Young filly, from eighteen to twenty months old, in her winter coat. She was obtained by D. Clemenz, from the Dzungarian Gobi, behind the Baityg-Bogdo Mountains, on the frontier of Charamelecetai. (Skin, No. 3,089; skull, No. 5,215.)

(8). An adult mare, obtained by D. Clemenz from the Dzungarian Gobi, between the boundary of Nursu and Simigendse. (Skin, No. 3,087; skull, No. 5,212.)

(9). An adult animal obtained from the same place by D. Clemenz. (Skin, No. 3,088.)

(10). A foal, ten months old, obtained by D. Clemenz from the Gobi Desert, at the Ebi Well, near the road from Kobdo to Barkul. (Skin, No. 3,072; skull, No. 5,211.)

(11). A young foal, of the same age as the last mentioned, and obtained from the same locality by D. Clemenz. (Skin, No. 3,073.)

(12). An adult stallion, killed in January, 1895, near Lake

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* One of these animals, the mare, died in December, 1901.

Gutschena, and obtained during the expedition of Roborovsky and Kozlov. (Skin, No. 3,094; skull, No. 5,218.)

(13). An adult stallion, obtained by D. Clemenz out of the herd of the Van's of Torgoutsk, on the River Bulunga. (Skin, No. 3,071.)

I have had two opportunities of inspecting the living specimens which Prince A. A. Oochtomsky, through the instrumentality of Vaissainaiv, obtained in May, 1901, in Kobdo, from the pasture lands of the Van's of Torgoutsk in West Mongolia. In 1901, the Prince very kindly granted me permission to examine these animals then in his stables. At the present time, they are in the Imperial stables at Tsarskoe-Selo, and, thanks to the kindness of the Minister of the Imperial Court, I have again had an opportunity of inspecting them. These horses have been photographed, and Professor P. O. Kovalevsky has produced a water-colour sketch of them, of which I give a photo-zinc copy (Frontispiece).

Up to the present, I have had no opportunity of seeing the horses which are the property of F. A. Falz-Fein. Thanks, however, to the kindness of Mr. Falz-Fein, I am able to give reproductions of photographs of his horses (Fig. 3). I am also indebted to the courtesy of G. A. Koshevnikoff for a short description of the animals written after special observations.

External Characters of Equus Prjevalskii.

CONFORMATION.—The external characters of *E. prjevalskii* have been repeatedly described. Poliakof[*] gave the first description, which was followed by a fuller one by N. M. Prjevalsky.[†] Grum-Grjimailo[‡] described living examples which he had seen in a state of liberty, and skins which he presented to the Zoological Museum. Tichonov[§] supplemented Poliakof's description by an account of specimens in the Zoological Museum of the University of Moscow (Expedition of Roborovsky and

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[*] Поляковъ, Лошадь Пржевальскаго (*Equus Przewalskii* n. sp.) 1881. Изданіе Императорскаго Русскаго Географическаго Общества. p. 10.

[†] Н. М. Пржевальскій. Третье путешествіе въ центральную Азію, Изъ Зайсана черезъ Хами въ Тибетъ и верховья Желтой рѣки. pp. 40–42.

[‡] Гр. Е. Грумъ-Гржимайло. Описаніе путешествія въ западный Китай. Изданіе Императорскаго Русскаго Географическаго Общества, 1896. pp. 118–211.

[§] А. А. Тихомировъ. Дикая лошадь Монголіи. (Естествознаніе и Географія 1898. No. 4.)

Kozlov, 1896), and specimens which he placed in the Zoological Museum of the Imperial Academy of Science. He referred to the dorsal stripe and to the stripes on the limbs: features which had already been mentioned by Poliakof.

The Prjevalsky horse has attracted the attention of a large number of zoologists interested in the classification of mammals. Consequently, the literature dealing with this species of *Equus* is very rich. In addition to the treatises already quoted, there are statements relating to *E. prjevalskii* in the works of Noack,[*] Böhm,[†] Kobelt,[‡] Lansdell,[§] Morgan,[‖] and Trouessart.[¶] And, quite recently, short communications by Grevé [**] and Matschie [††] have been published.

Langkavel, in his interesting work on the Asiatic wild horses, gives an account of the external characters of *E. prjevalskii*, according to Noack, Grum-Grjimailo and Prjevalsky.

In many cases the extant descriptions are wanting in accuracy; and some of them are surprising on account of their rather considerable subjectivity. The chief point with which fault may be found in the many systematic descriptions is that they are not based upon measurements of particular parts of the body. For instance, according to Noack, the ears of *E. prjevalskii* are shorter than those of the wild ass and *E. hemionus;* according to Prjevalsky, they are smaller than those of the ass; and, according to Grum-Grjimailo, they are remarkably short. Characteristics of such great importance as the length of the ears, by which a distinction is made between the horse and the ass, should be described with exactness if they are to possess systematic value. In other words, that such characteristics may be employed in classification, it is necessary, not only to know the absolute size of the ears, but also the proportion which their size bears to that of other parts of the body, and more especially to the size of the head. Only when this is known can we say with certainty that the ears of *E. prjevalskii* are smaller than those of the ass, or that they are remarkably small. On this account I have tried to obtain exact data of the dimensions of individual parts of the body of the Prjevalsky horse, and of the Asiatic ass. With this object, I have availed myself of the excellent plan of measurements given by Nathusius *; as, by it, may be stated a complete and lucid account of the shape of the horse described, and of the characteristics by which its classification is determined. Unfortunately the measurements were beset by certain technical difficulties. It would undoubtedly have been best to have taken them from living horses; but the animals which were at my disposal were so wild that it was not possible to measure them. In default of living material, I first took measurements of a stuffed skin of an adult *E. prjevalskii*, and of the young stuffed specimen upon which Poliakof's description was based. Subsequently, I measured the fresh body of an animal which had died in the Imperial stables. I have also compared the proportions which certain parts of the body bear to each other by means of photographs of living animals. It seems fair to presume that results so obtained are sufficiently correct. A possible error can only be very slight, since the relative proportions—as, for instance, the length of the head as compared with the length of the body—showed very little difference when the measurements taken from the photographs of living animals were compared with those of the skin. For the sake of brevity, I give an outline drawing (Fig. 2), after Nathusius, in which the various measurements are shown. The drawing is self-explanatory.

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[*] Noack (a) *Zoologischer Garten*, 1884, p. 331.
,, (b) *Natur*, 1892, p. 362.
,, (c) *Natur*, 1896, p. 264.
,, (d) *Deutsche Rundschau für Geographie und Statistik*, V. 6, p. 145; VII. 311.

[†] Böhm (a) *Geographische Jahrbücher*, V. 11, p. 182.
,, (b) *Russische Revue*, V. 13, p. 99.
,, (c) *Schweizerisches Centralblatt für Jagd- und Hundeliebhaber*, 1892, p. 76.
,, (d) *Deutsche Jägerzeitung*, V. p. 295.
,, (e) *Petermann's Mittheilungen*, 1896, p. 78.
,, (f) *Verhandlungen der Gesellschaft für Erdkunde*. Berlin, 1883, p. 498.

[‡] Kobelt. *Zoologischer Garten*, 1887.

[§] Landsell. *Chinese Central Asia*, V. 2, p. 28.

[‖] Morgan. *Annals and Magazine of Natural History*, VIII., 1881, p. 16.

[¶] Trouessart. *La Nature*, XVIII., 1890, p. 369.

[**] Grevé. *Equus Przewalskii* Poljakow im Moskauer Zoologischen Garten und einige Bemerkungen über das wilde Pferd überhaupt. *Zoologischer Garten*, XLII., 1901, pp. 275-282.

[††] P. Matschie. *Sitzungsber. d. Gesell. Naturforsch. Freunde, Berlin*, 1893.

As will be seen from the table herewith given, the Prjevalsky horse is about the same size as a small domestic horse. The adult stallion stands about 124 cm. (48.8 inches) at the croup †; and the length of his trunk is 127 cm. (49.9 inches). By his general conformation and in the respective proportions of certain parts of the body, he reminds one very much of the wild ass

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* Simon von Nathusius. *Unterschiede zwischen der morgen- und abendländischen Pferdegruppe am Skelett und am lebenden Pferde.*—Inaug. diss. Langensalza, 1891.

† According to Grum-Grjimailo, the height at the croup in a ten-year old animal amounted to about 147 cm.

(*E. hemionus* Pall.) and of its variety, the kiang (*E. hemionus* Pall. *var. kiang*, Moorkroft); but the Prjevalsky horse has a relatively larger head than the wild ass. The proportion of the length of the head to that of the body is as 1 : 2.21. In the onager the proportion is as 1 : 2.29; and in the kiang as 1 : 2.25. As regards the shape of the head, the Prjevalsky horse closely resembles the onager and the kiang: a fact already referred to by Poliakof, who added, however, that the head "is not so high and is more slender at the end of the muzzle and in the region of the bones of the nose." I can confirm the statement that the head of the Prjevalsky horse is very like that of the onager and the kiang; but I can obtain no proof that the end of the muzzle and the region of the nasal bones are more slender than in the Asiatic ass. The craniometrical observations which I made revealed no difference.

MEASUREMENTS OF PARTS OF THE BODY OF EQUUS PRJEVALSKII (FIG. 2).

Young mare which died at Tsarskoe-Selo.		The skin of an adult stallion (No. 3,094).	
α-β	= 508 mm.	α-β	= 560 mm.
γ-δ	= 141 ,,	—	—
aw	= 430 ,,	aw	= 470 ,,
Circumference of neck	= 900 ,,	—	—
Length of mane ...	= 150 ,,	—	—
ab	= 1,200 ,,	ab	= 1,200 ,,
gw	= 880 ,,	gw	= 950 ,,
gx	= 300 ,,	gx	= 400 ,,
gy	= 680 ,,	—	—
mnm	= 1,300 ,,	—	— ,,
cd	= 1,180 ,,	cd	= 1,190 ,,
ef	= 1,160 ,,	ef	= 1,240 ,,
ik	= 680 ,,	ik	= 720 ,,
gh	= 1,010 ,,	gh	= 1,210 ,,
lϑ	= 330 ,,	—	—
ϑ	= 175 ,,	—	—
lm	= 480 ,,	—	—
nn	= 240 ,,	—	—
r	= 150 ,,	—	—
Length of the whole tail	= 930 ,,	xw	= 1,270 ,,
		pq	= 720 ,,
Length of the caudal region of the vertebral column	= 350 ,,	vs	= 670 ,,
Length of the proximal (short-haired) part of the tail	= 250 ,,		
Circumference of the tail in its proximal part	= 160 ,,		

The average length of the ear was 140 mm. (5.5 inches) in five specimens (out of eight skins used for making measurements).

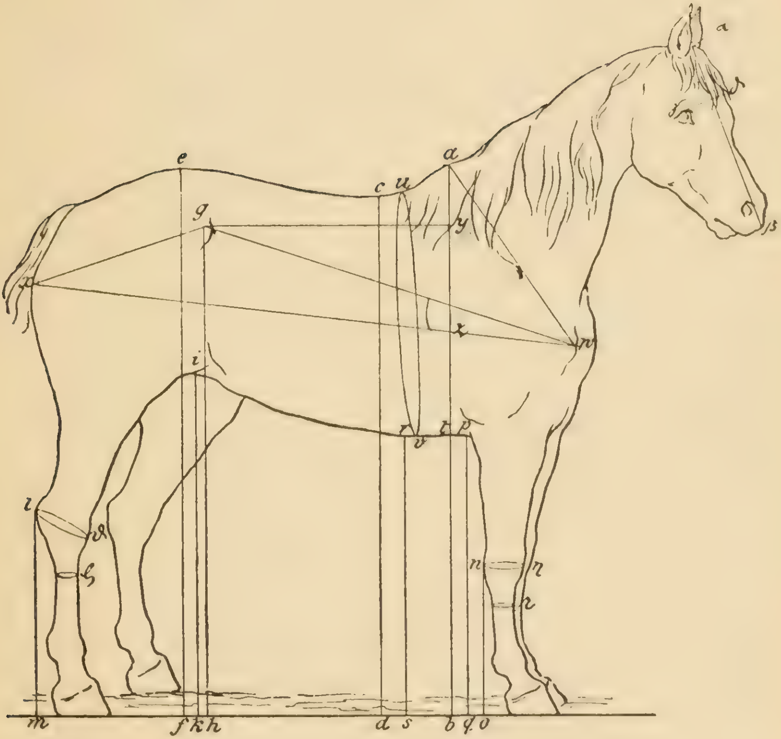

Fig. 2.

This is undoubtedly less than in the onager, the average length of whose ears I found to be 170 mm. (6.6 inches) in four stuffed specimens. The shortest pair of ears measured 165 mm. (6.4 inches), which is much longer than occurred in the Prjevalsky horse. The ears of the kiang are still longer than those of the onager, and averaged 200 mm. (7.8 inches) in three specimens. If the measurements obtained by Langkavel from the kiang in the Hamburg Museum are included, it is found that the length of the ear of the kiang varies from 180 mm. (7 inches) to 200 mm.; that is, the minimum length is greater than the maximum for the onager. In a specimen of the Prjevalsky horse (No. 3,094), the length of the ear is 170 mm.; and this is the greatest length of the ears of any specimen in the Zoological Museum of the Academy of Science. It should be borne in mind that the average length of the head of *E. prjevalskii* is greater than that of the onager or the kiang; and, therefore, the comparative length of the ear of the wild horse is much less than in the wild asses. Thus, in this particular, Prjevalsky's horse resembles more closely the domestic horse (*E. caballus*) than the Asiatic or African wild ass. As stated by the earlier investigators (Poliakof, Prjevalsky and Grum-Grjimailo,* the upper lip of *E. prjevalskii* overhangs the lower lip to a certain extent.

The neck is short and broad. It is shorter than the head, to which it bears the proportion of 1 : 1.12. Measurements show that the proportion of the length of the neck (from the occipital crest to the withers) to its breadth, at the widest part, is as 1 : 1.06. The mane, by its length, reminds one of the Asiatic wild ass. As previously stated by Poliakof, it is not very long; begins between the ears, and extends to the withers. Its anterior and posterior portions are short; but about the middle it has a length of from 16 to 20 cm. (6.2 to 7.8 inches). In his description of a dead Prjevalsky stallion, Grum-Grjimailo states that the mane hangs down on the left side of the neck; but Poliakof describes it as being erect. This apparent contradiction can be explained by the difference in the age of the specimens examined by the two writers. Poliakof's description applies to an animal eighteen months' old; whereas Grum-Grjimailo described a ten-year-old stallion. The mane stands erect in all the specimens of different ages in the Zoological Museum; and in no single case does it hang down. In the photograph of an animal described by Grum-Grjimailo—an eighteen months' old male—the mane is erect. The forelock of the Prjevalsky horse is about as little developed as it is in the onager and the kiang.

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* Op. cit.

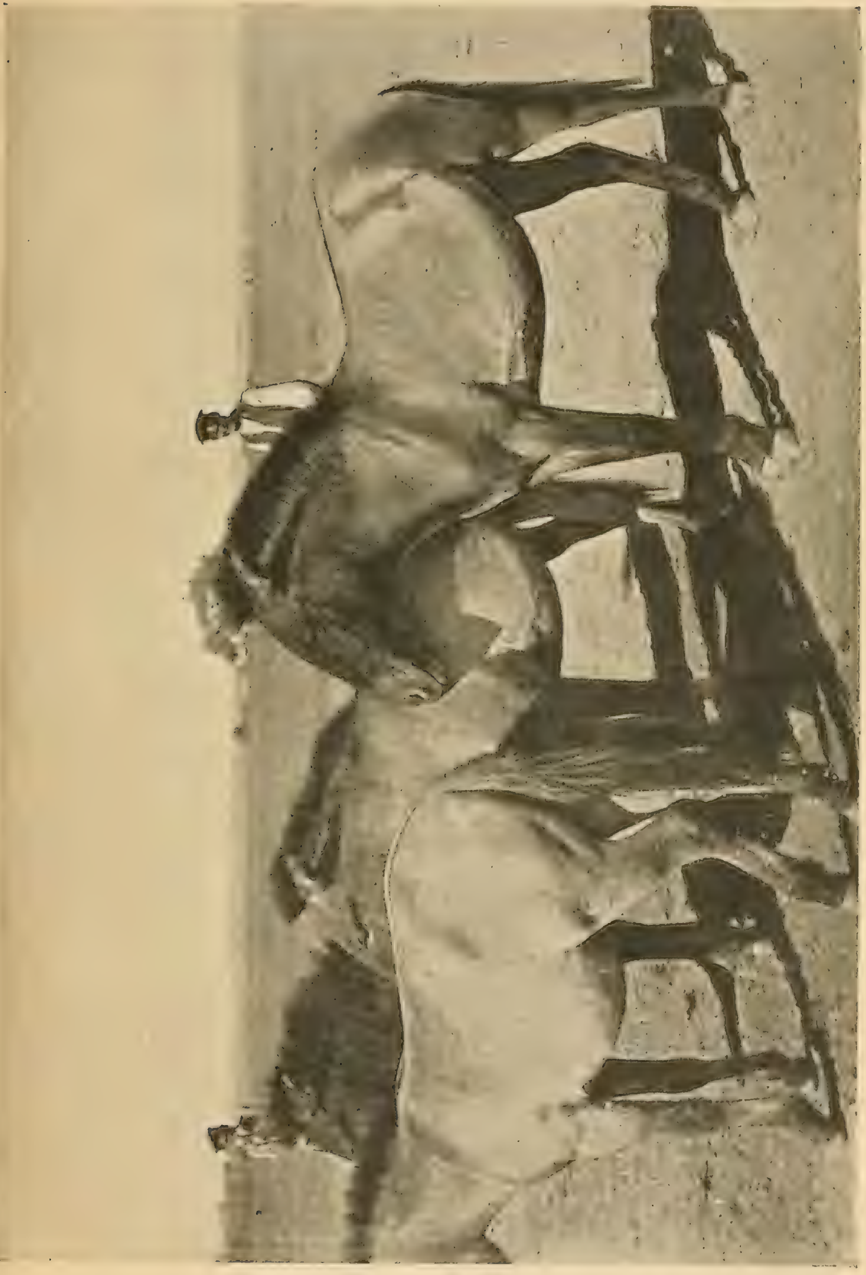

Fig. 3.—Prjevalsky horses in the possession of F. A. Falz-Fein, among them a bastard Zebra (to the left in the background).

The degree of curvature of the back varies greatly. In two living examples, in which this character can be best observed, the curvature is well marked in one (a mare) and only slightly so in the other (a stallion).

The tail is an extremely interesting feature of the Prjevalsky horse. It is quite peculiar, and resembles neither the tail of the onager nor that of the domestic horse, but is intermediate in form. It differs from that of the onager in that it is not sharply divided into two portions—a proximal part provided with tufts of short hair, and a distal portion covered with long hairs. It differs from the tail of the domestic horse, in that, for a certain distance from the root, its dorsal surface is covered with short hairs. Long hairs also begin close to the root, but they are present on the sides only, and, therefore, are below the short hairs. The tail is very long. In a foal at Tsarskoe-Selo it reached almost to the hoofs. The short stiff hairs on the dorsal aspect of the root are arranged in the form of two converging streaks enclosing a less prominent area, along the centre of which is a darker line forming a continuation of the dorsal stripe of the trunk. The hairs of the dorsal surface differ from the long hairs of the tail not only by their coarseness, but also in their colour. Poliakof states that the short hairs are of the same colour as those forming the dorsal stripe. This is correct so far as the winter coat is concerned; but, in the summer, these hairs differ conspicuously from those of the back by their lighter colour, and so resemble the light-coloured hairs of the edge of the mane.

Poliakof refers to the remarkable thickness of the legs of *E. prjevalskii*. In the living specimens which I have had an opportunity of examining, the legs were by no means thick. On the contrary, they might be described as slight, and looked rather long in comparison with the height of the animal.

The shape of the hoof forms an extremely important difference between the horse and the wild ass. In the ass it is somewhat long, and in the horse it is rounder. Measurements of twenty-two kiangs, five onagers and eight Prjevalsky horses, showed that in the last named the hoof is rounder than in the others—a difference of some importance. In the onager the width of the hoof is to its length as 100:140; in the kiang, as 100:149; and in *E. prjevalskii*, as 100:124. But the maximum and minimum length of the hoof is somewhat variable. In some specimens of the Prjevalsky horse the breadth of the hoof was to its length as 100:144; that is to say, the hoof was relatively longer than that of the average kiang. In the kiang the hoof is occasionally longer than in the onager, and, in extreme cases, a proportion of 100:168

may be attained, thus approaching the maximum for the onager (100 : 172.5). In general terms it may be said that the hoof has different average proportions in each of the three species of *Equus ;* but different individuals reveal considerable variation.

As Poliakof has already pointed out, the Prjevalsky horse has callosities (" chestnuts ") on both the anterior and posterior limbs. Their size is variable, but in general, as appears from the following table, the anterior callosities are much better developed than those of the posterior limbs, as is usually the case in the domestic horse. As a rule, the callosities are oval, but not regularly so, and generally the posterior are relatively narrower than the anterior. In position they agree with the callosities of the domestic horse.

Dimensions of the Limb Callosities of Equus Prjevalskii.

	Anterior.		Posterior.	
	Length.	Breadth.	Length.	Breadth.
No.	mm.	mm.	mm.	mm.
3,087	32	20	22	8
3,088	37	18	26	10
3,081	38	24	27	8
3,091	49	16	34	9
3,090	61	16	34	12
3,092	50	16	31	10
3,093	50	13	16	5
3,071	64	21	38	10
3,072	23	5	22	10
3,073	44	14	32	8
3,074	43	16	38	9

THE COAT AND ITS COLOUR.—The hair of the Prjevalsky horse is changed in winter and in summer. The first specimen known to science, captured by Prjevalsky and described by Poliakof, was in its winter coat, and, consequently, it was assumed by Poliakof that the hair of *E. prjevalskii* is long and curly. The winter and summer coats differ from each other, not only in length and texture, but also in colour and markings. The colour of the hair of the winter coat is lighter than that of the summer one. Poliakof correctly described the former as yellowish on the back, lighter over the sides and almost white on the under part of the body. Among the skins at the present time in the Zoological Museum both winter and summer coats are illustrated. Of the two living horses brought to the Imperial stables, one (a mare in her second year) had a winter coat, while the other (a stallion in his third year) had already assumed the summer coat. The difference between the two animals appeared to me to be very remarkable, and I was inclined, at first, to regard it as an individual peculiarity, but a closer study of the skins of Prjevalsky horses of different ages, and killed at different seasons, showed that the adult animals killed in winter had nevertheless a summer coat. This is illustrated by a ten-year old horse (No. 3,094), killed in January, 1895, during the expedition of Roborovsky and Kozlov. If these data are reliable, it may be assumed that the tendency to change the summer coat for a winter one diminishes with increasing age.

In *E. prjevalskii*, a change of hair probably occurs in the spring, and takes place very slowly, as is the case with some of our domestic horses. This can, naturally, only be proved by the observation of living animals. The summer coat is much shorter than the winter one, and it is smooth and not curly. The hair is about as long as that of the onager and the kiang, which it further resembles in colour. The colour of the back is a light reddish-brown. This shade extends over the sides and gradually merges into the yellowish-white of the under part of the body; so that there is no sharp line of demarcation between the back and the flank, and between the flank and the belly. The head is of the same colour as the back, except that the lips and the end of the muzzle in the region of the nostrils are white. Between the nostrils the white colour changes into grey. The ears are light brown at the base, and dark brown at the tip; while the interior is covered with white hair.

When in its winter coat, the Prjevalsky horse has tufts of hair—which Poliakof termed "whiskers"—on the sides of the head. In the summer coat these can hardly be distinguished; the hair of the cheek being of almost the same length as that on other parts of the body. In summer, however, there are long tufts of hair under the jaw, which present the appearance of an elongated beard. The mane, which begins between the ears and extends to the withers, consists of erect hairs of two colours: dark-brown and light grey; the latter being usually shorter than the former, and gathered into tufts. The hair of the mane is harder than the hair of other parts of the body.

Behind the mane the dorsal stripe extends along the entire back, in the form of a narrow (about 5 mm. broad), reddish-brown (darker than the hair of the back), straight band which, like the dorsal stripe of the onager and the kiang, is continued on to the tail (Fig. 4). The dorsal stripe can be fairly readily distinguished running along the dorsal side of the proximal part of the tail between the light grey erect hair of this region, but it can only be plainly seen in those animals which carry the summer

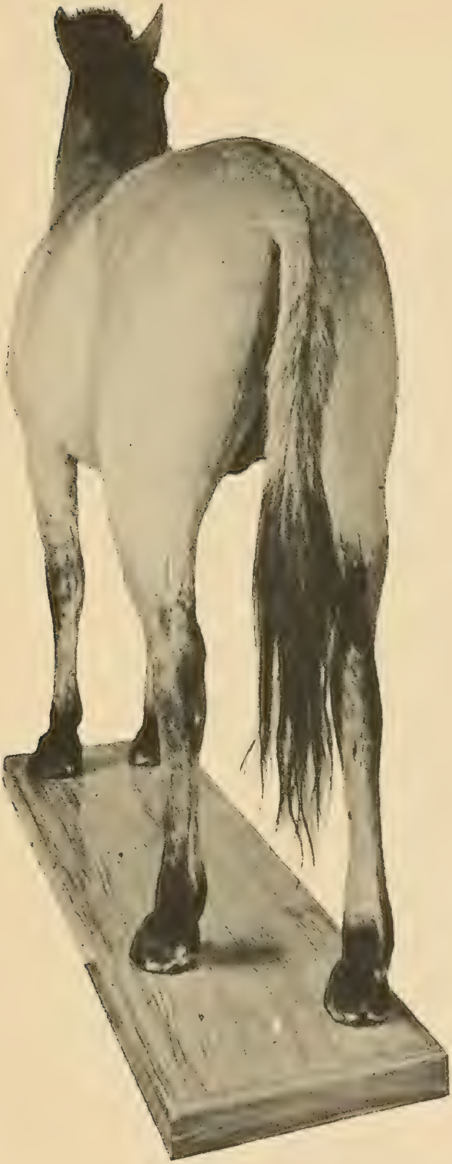

Fig. 4.—*Equus Prjevalskii.* Stuffed specimen.

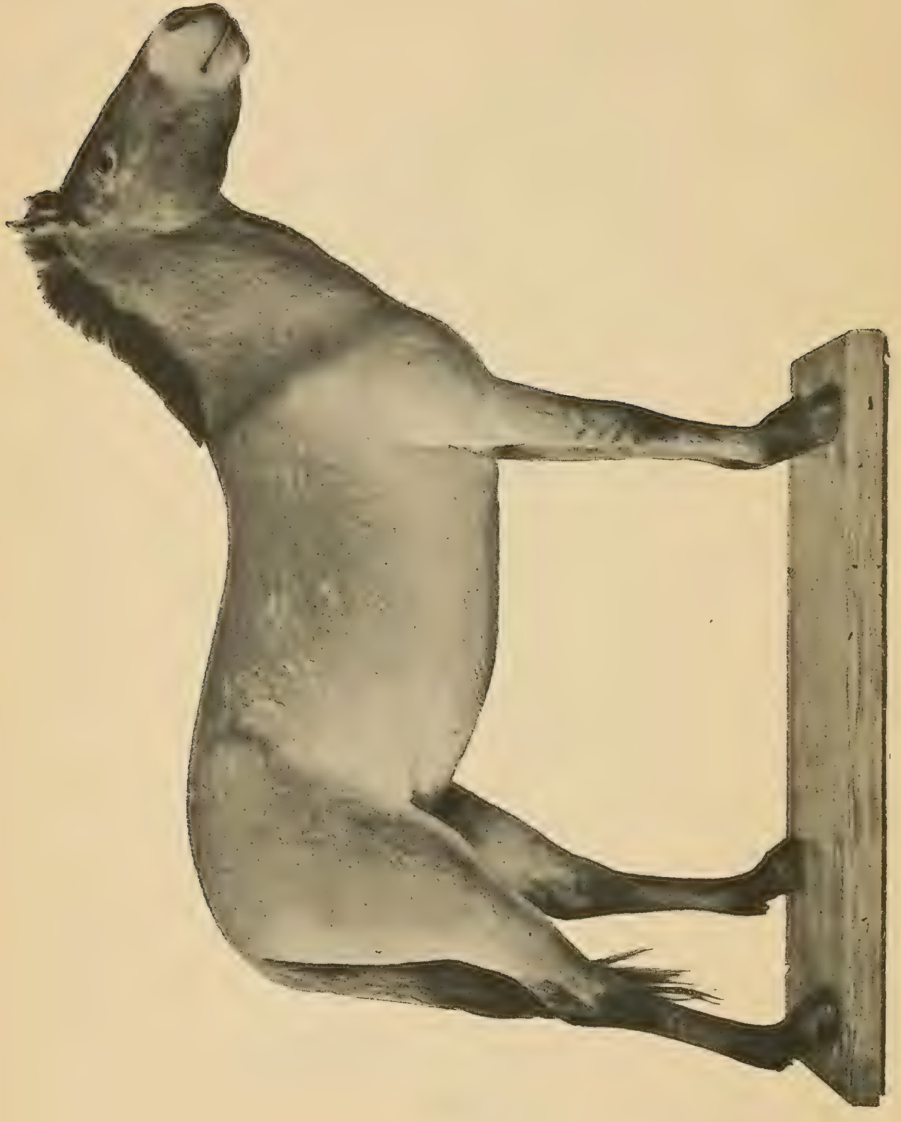

Fig. 5.—*Equus Prjevalskii.* Stuffed specimen.

coat. In young animals with a winter coat, it can be distinguished only on the hind quarters close to the root of the tail; on which account it escaped Poliakof's notice. No dorsal stripe is mentioned in those later accounts of *E. prjevalskii*, which were founded upon Poliakof's description. Poliakof, however, saw the trace of the stripe on the tail, and described it correctly. Tichonov,* whose description was based upon an examination of the specimen in the University of Moscow (obtained by the Roborovsky-Kozlov Expedition), and on the specimen in the Zoological Museum of the Academy of Science, was the first to give a full and correct account of the dorsal stripe, because he was dealing with examples with a summer coat. Although attaching great importance to this feature, he held that it played no part in the solution of the question as to whether Prjevalsky's horse is a true wild horse or an animal more closely related to the Asiatic wild ass, since the dorsal stripe is met with in both horses and asses, and may be absent in either. The stripe, though darker than the rest of the coat, has the same reddish-brown tinge.

Another interesting feature in the Prjevalsky horse is the transverse shoulder stripe, which is in exactly the same position as that of the domestic ass and its ancestor, the African wild ass. It is not nearly so well marked as it is in the ass, but nevertheless it can be clearly distinguished in the living specimens at Tsarskoe-Selo. Broader and lighter than in the ass, it is of a brown colour; without sharply defined margins; and much more plainly marked in the summer than in the winter coat; although even in the latter it can be recognised. In the accompanying photograph (Fig. 5) the shoulder stripe appears fainter than it was in the actual specimen. Of the two horses at Tsarskoe-Selo, the stallion has a broad brown stripe with distinct margins; but in the young mare, in which the hair of the body is much darker and, consequently, of a greyish tinge in some regions, the stripe is black in colour, much narrower than in the stallion and more sharply defined.

The legs of *E. prjevalskii* are entirely different in colour from those of the Asiatic ass; inasmuch as, in the latter animal, the lower part of the limbs down to the hoofs is always of a light colour, whereas in the Prjevalsky horse the colour is more or less black, according to the age and individual peculiarities of the animal. In young animals, however, the black is occasionally replaced by grey, and, in very rare instances, by white (as was the case in a new-born foal I saw). In adult animals a black ring extends some 80 mm. ($3\frac{1}{4}$ inches) above the hoof. From this to the fetlock, the outer side of the limb is covered with black hairs; but, on the inner side, the hair is grey with transverse bands, which are present as far up as the knee. Poliakof, referring to the presence of these transverse stripes, states that they are indistinct. This is so in the specimen which served for his description, since it was in the winter coat. In adult animals with a summer coat, on the other hand, they are generally very pronounced, although they may vary considerably in number and arrangement. In certain horses (for instance, No. 3,071), I have counted as many as five transverse bands; but in foals, in which the legs are not so intensely coloured, they are occasionally absent. Further, in other animals (No. 3,090, for example), they are light in colour and few in number. Transverse stripes are especially well marked in the specimen (No. 3,074) obtained by the brothers Grum-Grjimailo. They do not constitute complete half-rings, but are in the form of two stripes interrupted on the inner side of the limb.

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* Op. cit.

As far as the fetlock, the lower part of the inside of the limb is of a reddish colour, this gradually merging into the black of the outer side. Above the fetlock the reddish tone is lighter, and, becoming gradually paler, is finally as white as the hair of the belly.

The living specimens at Tsarskoe-Selo and Askaniyá Nova show many interesting peculiarities, the recital of which I consider to be here necessary. All the following particulars relating to the Tsarskoe-Selo horses have been obtained by personal observation; but, as I was not able to see the horses myself, the information regarding the Falz-Fein animals has been supplied by Koshevnikoff, to whom I am greatly indebted.

The three-year-old stallion and the two-year-old mare at Tsarkoe-Selo possessed fairly well-marked differences. The general colour of the mare was greyer than that of the stallion, in which there was a reddish shade. The white patches on the abdomen of the stallion were smaller and fewer in number than in the mare, and confined to the flanks; while on the mare similar patches were also present on the thighs and shoulders. The colour of the neck was the same in both the stallion and the mare. Pale spots were absent from the neck; this being a peculiarity which distinguishes *E. prjevalskii* from the Asiatic wild ass, the under part of whose neck is whitish. The "whiskers" could be easily distinguished in the stallion, whose winter coat at the time of examination (October 18th) had begun to grow. On the nose of the mare there was a grey patch, consisting of black and white hairs, not sharply defined but gradually merging into the brown colour of the forehead. The space between the nostrils was of a red-brown colour. The outside of the nostrils was surrounded with white hairs. The lips of both the stallion and the mare were black.

In the mare the black colour of the legs extended above the fetlocks; but, in the stallion, it did not come so high up as these joints, and was, in general, less dark. The mare had four well-marked black stripes on the legs; but stripes were very poorly developed in the stallion. Owing to the presence of a large quantity of yellow hair, the lower part of the legs of the stallion was mottled in colour; whereas, in the mare, it was of uniform black.

Respecting the Prjevalsky horses belonging to Falz-Fein, I quote the following letter from Koshevnikoff *in extenso:*

"Among the interesting animals which are at Askaniyá Nova, there are three Prjevalsky horses, and two supposed crosses between a domestic mare and a Prjevalsky stallion.

"All five animals arrived at the Falz-Fein estate in the spring of 1900. In all, five unweaned foals accompanied by four Kirghiz brood mares were handed over. They were obtained as newly-born animals in 1899, and had apparently wintered in Büsk.

"All the specimens were mares. They grazed in the open, in company with the two supposed cross-bred animals and an onager, under the care of a special herdsman. If these wild horses were driven into an enclosure, they would allow no one to approach nearer than four or five yards without becoming excited."

The following is a description of the individual animals:

"No. 1. The largest and darkest coloured. The stable servants of the place consider it to be cream-coloured. Personally, I would say that it is of a dun or fawn colour; but I must admit that the determination of the colour of the Prjevalsky horse is very difficult on account of its indefiniteness, and owing to the vagueness of the terms employed.

"The different parts of the body are differently coloured. The legs are dark and even black below. Callosities are present on all the legs; the anterior ones being above the joint, and the posterior below the joint. On the fore legs there are two not very well marked stripes.

"The muzzle resembles that of an ordinary horse. There is a dark spot on the forehead. The upper lip is white, and the upper part of the nostril is of a whitish-yellow colour.

"The dorsal stripe is well marked and is broader than in the other animals. The tail has no long hair for a distance of two werschok (about $3\frac{1}{2}$ inches) from the root. The mane is erect, about $\frac{1}{4}$ arschin (7 inches) high, black down the centre and yellow at the sides. A striping, such as Tichonov described as being present in a skin in the Moscow Zoological Museum, is not apparent.

"No. 2. Lighter in colour than No. 1, and smaller (corresponds in height with No. 3). Dorsal stripe narrower. Legs are the same as those of No. 1, but darker low down. Three stripes on each leg. Traces of a fourth stripe on the right fore limb.

"Muzzle white, and whitish-brown farther back. The nose is less convex than in our skin. The mane is dark fox-red (brownish) in the middle, and lighter at the sides; but the difference in colour is not so well marked as in No. 1. The ears are of a fox-red colour, with black points. The shoulders are light. The lower part of the belly is yellowish. The callosities on the posterior limbs are large, long and placed near the posterior border of the limb.

"No. 3 is the lightest coloured specimen. The dorsal stripe is very narrow. By their colour, the light parts of the body remind one very much of the light parts of the onager. The front of the muzzle is similar in colour to that of the onager. The neck is light brown, and the belly is quite white. The under side of the abdomen, especially close to the legs, is white. The shoulders and buttocks are very light in colour.

"The muzzle is white; the forehead is light brown; and the ears are very light in colour. The nostrils are dark, as in the rest of the animals. The left fore limb has four stripes; two of the other limbs have three stripes; and one has only two stripes. The lower part of the limb is very dark coloured.

"Half-bred (?) horses. According to the statements of the inhabitants of the districts from which the wild horses were brought, two ordinary mares were covered by wild stallions in the Steppe, and the supposed half-breds are the product of this union. Their colour is brown with a dark grey tinge. One animal is light coloured; the other is dark. Dorsal stripes are present. The muzzle is white, and, in one of the animals, the region of the nose is pure white. There are no stripes on the legs. The mane long and the forelock short, as if it had been sheared off. No double colouring is seen in the mane. The tail is like that of an ordinary horse."

According to the foregoing description of the external characters of *E. prjevalskii*, Poliakof's diagnostic signs * should be altered as follows: Mane short, no forelock, dorsal stripe and transverse shoulder-stripe present, and the proximal part of the tail bristly.

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* Op. cit. p. 2.

THE SKELETON.—The Zoological Museum of the Academy of Science possesses only one skeleton of *E. prjevalskii*, and this is incomplete. It consists of a skull, the vertebral column, the innominate bones and the bones of the left extremities. It is the skeleton of a young male (No. 3,092), killed by G. E. Grum-Grjimailo, and presented by him to the Zoological Museum. It is clear that measurements taken from it cannot give any exact data as regards the dimensions of the bones of the mature *E. prjevalskii*. In addition to this skeleton, the Museum possesses nine skulls which belong to the skins Nos. 1,523 (18 to 20 months old), 3,072 (10 months old), 3,074, 3,089 (18 to 20 months old), 3,093 (18 to 20 months old), 3,094, 3,087, 3,092 and 3,090.

THE SKULL.—Craniometrical observations of the Prjevalsky horse have already been made by my two predecessors, Poliakof and Czerski.* Both of these undertook the measurements of the single specimen that was obtainable at that time, and compared the results with measurements of the skulls of the Asiatic ass, the African donkey and the ordinary horse. Czerski had richer material at his command than had Poliakof, and his measurements were more precise. He also employed the methods which Nehring had described in his well-known work, "Fossile Pferde aus deutschen Diluvial-Ablagerungen" (Landwirthschaftliche Jahrbücher, 1884), to which he added certain measurements that Nehring had omitted. At the present time, the Zoological Museum not only possesses a far greater number of Prjevalsky horse material, but also the number of kiangs and onagers has been largely increased by many expeditions into Central Asia. Consequently, more complete measurements can now be accomplished than was possible in Czerski's time.

Altogether I have made measurements of sixty-four skulls; namely, nine of the Prjevalsky horse, fifteen of the domestic horse, one of the mule, eighteen of the onager, eleven of the kiang, six of the ass, one of the mountain zebra, one of the Grevy zebra, one of the Burchell zebra, and one of the Chapman zebra. Taking into account Nehring's craniological measurements of the large number of skulls in the Museum of the Berlin Agricultural College, we have now a very considerable amount of data at our command as a means towards the solution of the question respecting the nature of the Prjevalsky horse.

I wish to preface the discussion of my measurements by a few words on craniological measurements in general. These already play an important part in the systematic classification of mammals, although the methods employed have only recently been elaborated. Consequent upon the recent nature of the application of craniometry to mammals in general, different authors choose different bones and different points of the skull from which to make their measurements, with the result that there are divergences in the results of researches not only in skulls of different genera and species, but also in those of the same species. Some authorities make the mistake of giving too many measurements: others give too few. The former furnish unnecessary material which mars the clearness of the conclusions; while the incompleteness of the measurements of others comes into prominence when their researches are employed for the purpose of determining if a given skull belongs to this or that species.

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* П. Д. Черскій. Описаніе Коллекціи послѣтретичныхъ млекопитающихъ животныхъ, собранныхъ Ново-Сибирскою экспедиціею 1885-86 г. Приложеніе къ LXV-му тому записокъ Имп. Акад. Наукъ. 1891 г.

The object of the study of the skull and of craniological measurements should be the discovery of essential and specific characteristics by which a given skull may be distinguished from the skulls of closely allied genera and species. In many mammals, rodents for instance, not only does the relative size of certain parts of the skull serve as a specific character, but so also does the absolute size. Although the horse does not come into this category, nevertheless the absolute figures of the skull measurements can be used advantageously, to a certain extent, for purposes of determination, as was demonstrated by the measurements made by Franck,* Nehring and Czerski, and by the tables drawn up by myself.

Great credit is due to Nehring as being the first to devise a rational method of craniometry by which the characteristic configuration of a skull could be demonstrated. To the measurements used by Nehring, Czerski added others; with the result that the number now employed is considerable. Nehring's most important measurements were for the purpose of indicating the width, length and height of the skull and the mandible. The width of the skull he took at three points: (1) the distance between the posterior margins of the orbital cavities—*Frontal width;* (2) the distance between the zygomatic ridges of the superior maxillary bones—*Facial width;* and (3) the transverse distance between the most prominent parts of the nasal region—*Nasal width.* Of these, Nehring considered the frontal width to be the most important, and compared it with the length of the base of the entire skull *(Basilar length)*, and with the length of the upper surface of the whole skull *(Length of the vertex).* These relations he indicated by his *Index I.* and *Index II.* The length of the skull is measured (1) along its base from the lower border of the foramen magnum to the base of the middle incisor teeth *(Basilar length of the skull)*, and (2) from the edge of the occipital crest along the external upper surface of the skull to the base of the middle incisor teeth *(Length of the vertex of the skull).* In taking the height of the skull, Nehring included the lower jaw. Such a measurement is not satisfactory, because the lower jaw is liable to considerable variation which would naturally influence, to a great extent, the total measurement; whereby no exact idea of the height of the real cranial box could be conveyed. It is, therefore, better to follow the example of Czerski and add a diameter of the height of the cranium, measured from its base to the summit of the occipital crest. I have adopted such a measurement in my own observations.

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* Franck. Ein Beitrag zur Rassenkunde unserer Pferde. *Landwirthsch. Jahrbücher*, IV., 1875.

Nehring determined the position of the orbital cavity, as regards the lateral surface of the skull, by means of two measurements which, taken together, constitute his *Ocular line* (Augenlinie). These are as follows: (1) from the occipital crest to the most external point on the posterior border of the orbital cavity *(posterior segment of the ocular line)* and (2) from the most external part of the posterior border of the orbital cavity to the base of the middle incisor *(anterior segment of the ocular line).* If the posterior segment of the ocular line be taken as 100, the relation of its length to that of the anterior segment gives Nehring's *Index III.—Ocular index* (Augenindex).

Respecting Nehring's ocular line, Czerski * correctly remarks that it gives no idea of the proportion which the facial part of the skull bears to the cranial part. In order that his measurements might indicate the ratio between the length of the face and the length of the cranium, Czerski added another diameter, taken from a point between the central incisor teeth to the nearest part of the anterior border of the orbital cavity. From the relation of this diameter to the basilar length of the skull he computed a *Facial index.* Although in entire agreement with Czerski regarding the necessity for some expression of the ratio of the cranial part of the skull to the facial part thereof, I do not find that his index is satisfactory. And for these reasons: (1) because the anterior border of the orbital cavity does not coincide with the junction of the cranium and face, and (2) because the parietal measurement is referred by Czerski to the basilar length. The relation of the parietal length of the skull to its basilar length is liable to great variation. For these reasons, I have taken a facial length from the base of the incisor teeth to the point of union of the frontal and nasal bones, and have compared this diameter with the length of the vertex of the skull. The relationship thus obtained I have indicated in a *Facial index*, or *Index IV.*, in computing which the length of the face is taken as 100. In this index I also include the relation of the length of the cranium to the length of the vertex of the skull.*

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* Op. cit. p. 378.

The orbital cavities were measured horizontally and vertically In order to determine the width of the cranial part of the skull, I measured the distance between the most prominent points on the parietal bones, and the distance across the narrowest part of the skull, *i.e.*, on a level with the root of the post-orbital process of the frontal bone. In this way, the broadest and narrowest diameters of the cranium were ascertained. In addition, the width of the skull between the upper edges of the external auditory meati was determined. In order to ascertain the width of the face, I measured its broadest and narrowest parts in the manner suggested by Czerski.

Further measurements of the skull refer to the length of the series of cheek-teeth, taken, naturally, only from the skulls of full-grown horses in which the full complement of teeth was present. Following Nehring's method, two measurements were made; one along the bases of the teeth, the other along their wearing-surfaces. The height and length of the lower jaw were also ascertained by Nehring's method. The height of the nasal region, in consonance with the plan adopted by Czerski, was measured from the posterior edge of the last molar tooth to the middle of the inter-nasal suture.

A very important matter in these craniological investigations is the proportion which the distance from the foramen magnum to the edge of the vomer bears to the distance from the vomer to the palatine bone. Franck has indicated that this is different in the skull of the horse and of the ass; since, in the ass, the first-mentioned distance is smaller than the second, whereas, in the horse, the second is smaller than the first. Nehring, in general, agrees with this view, but he found, in the skull of an African ass, that relationship of the two distances which is held to be characteristic of the skull of the horse. Nevertheless, these measurements are very important as a fairly good indication of a characteristic

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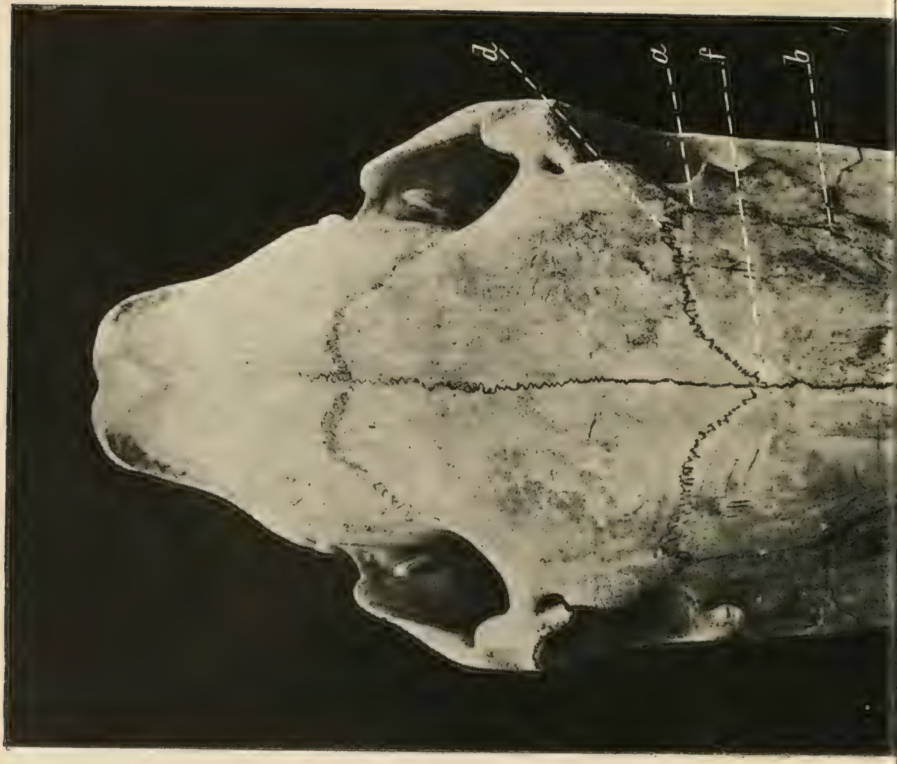
* For this reason Index IV. is represented in the accompanying tables by two numbers, an upper and a lower. The upper refers to the relation of the length of the face as compared with the length of the vertex; the lower to the length of the cranium in the same comparison.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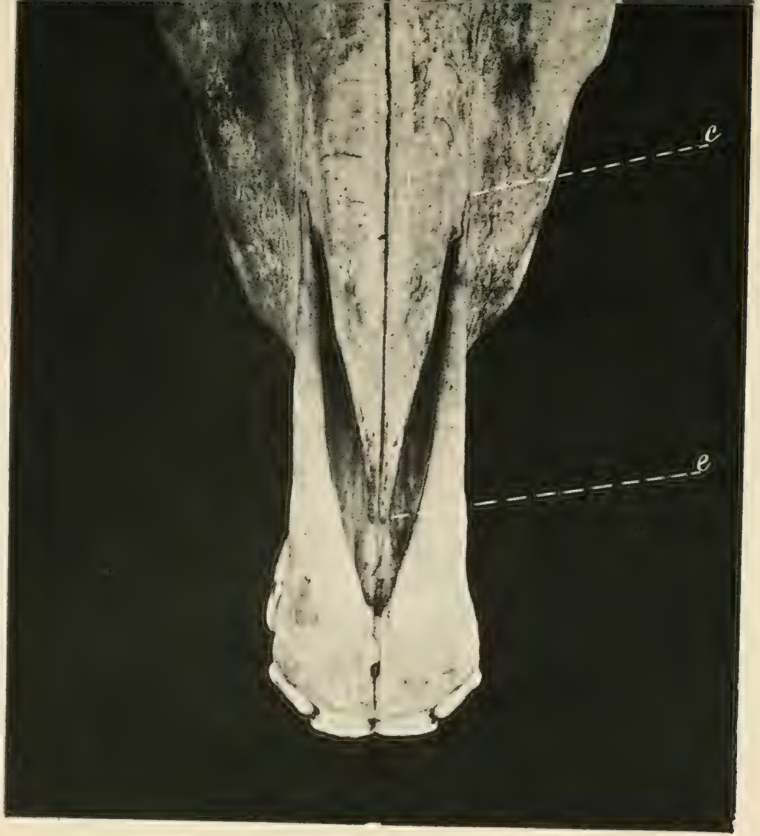

Fig. 6. Skull of *Equus prjevalskii.*

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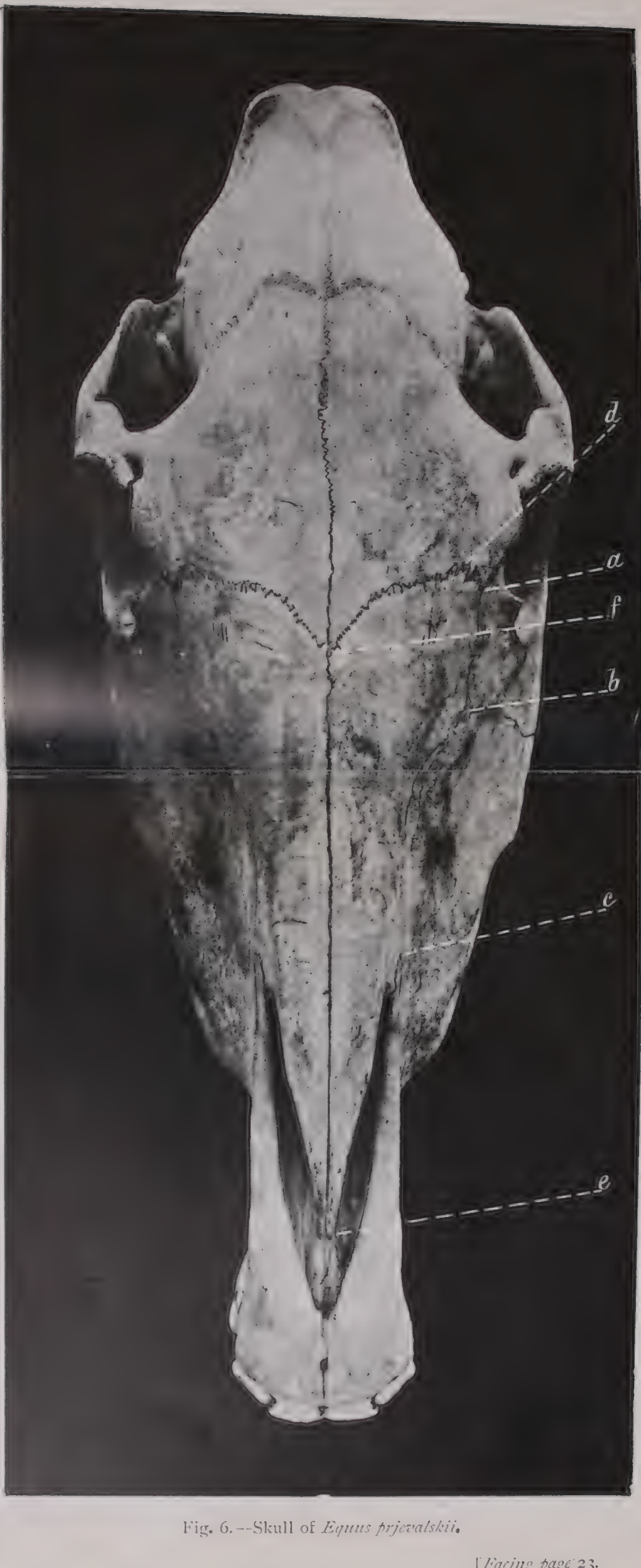

Fig. 6.--Skull of *Equus prjevalskii*.

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difference between the skull of the horse and that of the ass, and give interesting results when applied to the skull of the Asiatic wild ass. The ratio which the two diameters bear to each other will be indicated in the following by *Franck's index*.

The most important point in the study of the skull of *E. prjevalskii* (Fig. 6) is its comparison with the skulls of other species of the genus *Equus*, namely, the horse, the Asiatic ass and the African ass. In *E. prjevalskii* we have to do with a form which, in many respects, is intermediate between the horse, on the one hand, and the ass (Fig. 7) (including the Asiatic wild ass), on the other. On this account, as accurate an examination as possible must be made of each feature which can help to solve the question of relationship. Franck * alludes to nine characteristics which, in his view, represent points of difference between the horse and the ass. Because all of them cannot be shown to be suitable for determining the classification of the different species of the genus *Equus*, I shall only mention one of Franck's characteristics—to which reference has already been made—namely, the ratio the distance from the foramen magnum to the vomer bears to the distance from the vomer to the posterior border of the palatine bone. Czerski † who was also convinced of the inadequacy of the majority of Franck's characteristics, gave such of them as by careful test he had proved to be most important. These referred to the shape of the nasal and lachrymal bones, and the form of the naso-lachrymal suture. In the ass, the superior (nasal) border of the lachrymal bone is concave, whereas in the horse it is straight. A further difference is the position of the infra-orbital foramen, which is much farther from the nearest point on the naso-maxillary suture in the ass than in the horse. In the horse the post-orbital process of the frontal bone is three-sided: in the ass it is oval and compressed.

There are, therefore, a series of craniological features which serve to differentiate the skulls of the two species of the genus *Equus*. These are: Franck's index, the form of the nasal and lachrymal bones and of the suture between them, and the shape of the post-orbital process of the frontal bone. To these may be added less important features—such as the shape of the lower jaw, the length of the series of the cheek-teeth—to which reference will be made later.

Franck's index, and its significance, can be verified by measurement. The correctness of Franck's conclusion was confirmed by the examination of thirteen skulls of different breeds of *E.*

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* Op. cit. p. 41.

† Op. cit. p. 399-402.

caballus. Not a single skull proved an exception to Franck's rule, although the difference between the distance from the vomer to the foramen magnum, and the distance from the vomer to the palatine bone, varied considerably (from 9 to 35 mm.) in different skulls. In this respect all the specimens of *E. prjevalskii*, without exception, exhibit the same peculiarity as does the domestic horse; but in both young and old animals the variation in the difference of the two diameters is less marked, being from 7 to 15 mm.

All the results I have obtained from the examination of skulls of the ass allow me to confirm Franck's conclusions. The distance from the foramen magnum to the vomer was less, in all the skulls examined, than that from the vomer to the palatine bone; the difference ranging from 6 to 15 mm. In the single skull of the mule which was at my disposal, Franck's index resembled that of the horse. The distance from the foramen magnum to the vomer was about 5 mm. greater than the distance from the vomer to the palatine bone. In the onager and kiang, Franck's index was of great interest, because of its extreme variability. In some specimens it had the characters of that of the horse's skull; in others it resembled that of the ass. Of seventeen skulls of the onager, four showed the horse type of index; and the remaining thirteen the ass type. Of eleven skulls of the kiang, six had an index resembling that of the horse; and the remaining five, the index of the ass. With respect to Franck's index in *E. hemionus*, Nehring* remarks that the Dshiggetai (probably a Thibet kiang) is closely allied to the domestic ass. In Nehring's tables, *E. hemionus* is represented by only one skull, which, as it happens, shows the characters of the ass and not of the horse. Measurements of many skulls show that Franck's index is not characteristic for the Asiatic wild ass; though, according to my own measurements at any rate, it is one of the best features for the distinction of the skull of the donkey from that of the horse.

From the measurements of the skull of an African ass, Nehring obtained a Franck's index like that characteristic of the horse. Endeavouring to explain this anomaly, he says that perhaps it is the consequence of prolonged domestication. I prefer, rather, to descry in this case an indication that *E. asinus* is allied to an ancestral form from which the horse and the Asiatic ass have descended. In such a form, there would be an approximation, in part to the horse type of Franck's index, in part to the ass type; such as has been observed in the Asiatic wild ass. Perhaps *E. hemionus* is more closely allied to that original general type from

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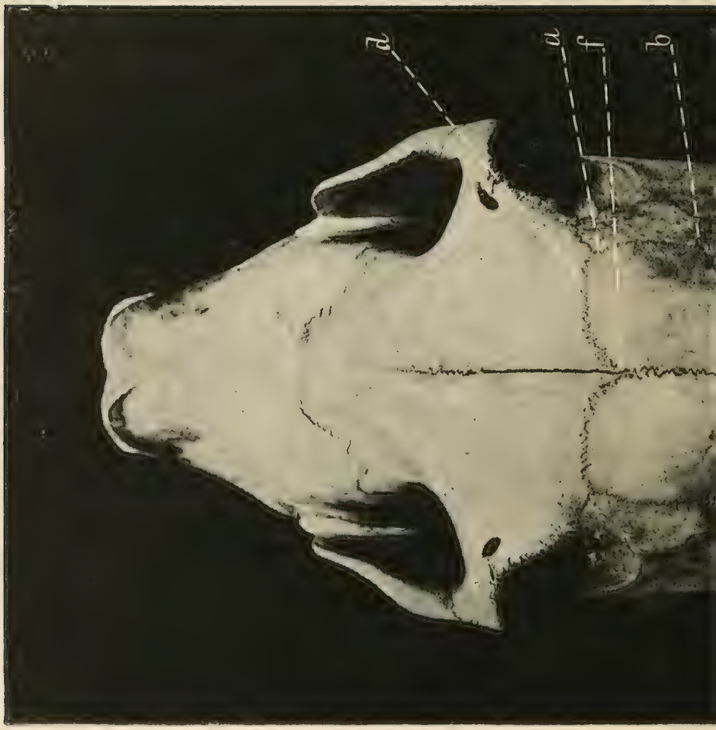
* Op. cit. p. 111.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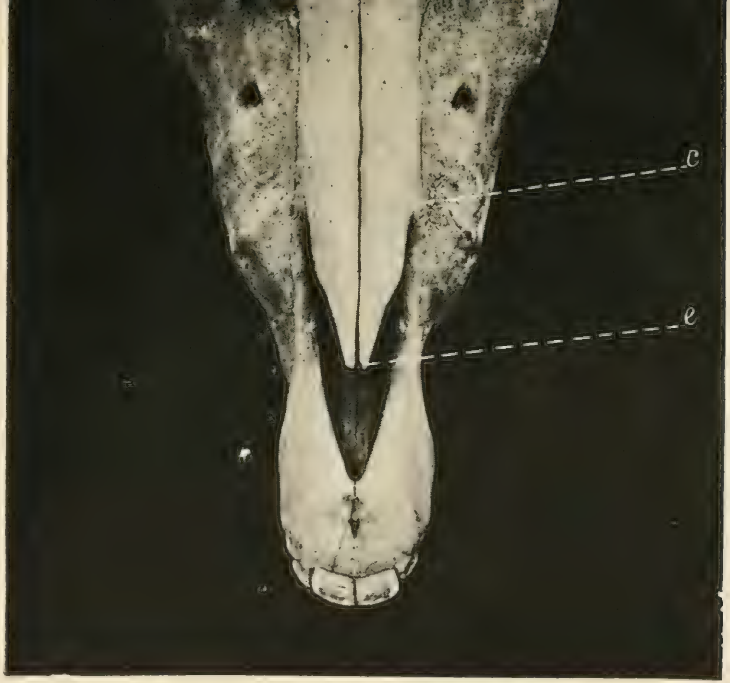

Fig. 7. Skull of *Equus asinus*.

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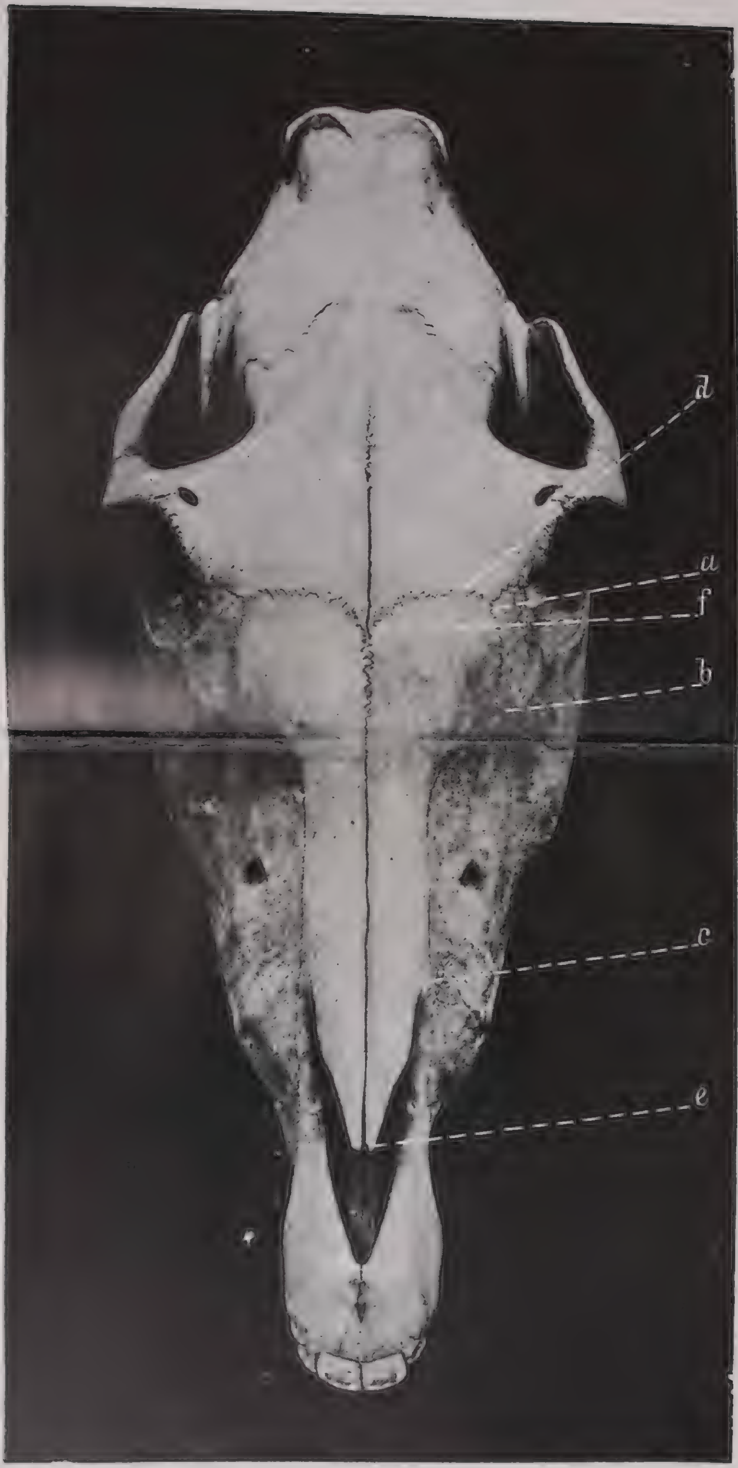

Fig. 7. Skull of *Equus asinus*.

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which sprang the two species of horse *(E. caballus* and *E. prjevalskii)* and the donkey *(E. asinus)*.

Unfortunately I have only a few skulls of the zebra at my disposal (two of *E. zebra;* one of *E. grevyi;* one of *E. burchelli*, and one of *E. burchelli* var. *chapmani)*. So far as one can judge from the measurements of so few specimens, Franck's index varies greatly in the zebra. The index resembled that of the horse in both specimens of *E. zebra*, and that of the ass in all the other zebras.* Nehring's measurements,† which include those of several specimens of *E. zebra*, indicate that Franck's index is not always of the same type in this species; since two out of three skulls exhibited the ass type of index, while, in the third, the index resembled that of the horse. It is evident that, for neither the zebra nor the Asiatic ass, is Franck's index characteristic or diagnostic.

The fronto-nasal region, consisting of the frontal, nasal and lachrymal bones, forms a characteristic part of the skull, and serves well as a feature by which a horse's skull may be distinguished from that of a donkey (but not from that of the Asiatic ass). In this region, the nasal bones are of great importance, since upon their configuration depends the shape of the frontal and lachrymal bones, as well as the form of the naso-lachrymal suture. Consequently, measurements of the nasal bones have been included in the accompanying tables. Before reviewing these, however, it will be well to discuss the individual bones and sutures of the region.

By the form of the naso-lachrymal suture, the skull of the horse may be distinguished from that of the ass (Czerski).‡ In the horse the suture is straight and nearly parallel with the long axis of the skull; but in the ass it is curved and convex towards the lachrymal bone. Therefore, the inner border of the lachrymal bone is straight in the horse, and concave in the ass. This peculiarity is very constant, although in certain asses the degree of the curvative varies somewhat; and, in certain horses, the commonly straight suture may be curved. The unusual curve may be directed either towards the lachrymal bone or towards the nasal. Naturally, in the latter case, the border of the lachrymal bone is convex instead of concave. In the Asiatic ass *(E. hemionus)*, the form of the suture resembles that of the donkey, and its curvature is occasionally very decided. In *E. prjevalskii* the suture is like that of the horse.

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* My measurement of the skull of the zebra No. 111 agrees with that given by Poliakof. Czerski avers that Poliakof gave the figures in inverse order: that is, that the distance from the foramen magnum to the vomer as compared with the distance from the vomer to the palatine bone should read as 103 : 111; and not, as Poliakof states, as 111 : 103. I can, however, affirm that Poliakof is correct, and that Czerski is in error.

† Op. cit. pp. 98-101 and 111.

‡ Op. cit. p, 399.

In both the horse and the ass, the nasal bone consists of a broad posterior part, and a narrow anterior portion. In the ass the bone narrows rapidly anteriorly; but in the horse the narrowing is gradual. The nasal bones of the ass may, therefore, be described as club-shaped; and those of the horse as wedge-shaped. The form of the posterior part is not the same in the horse and the ass. In the horse the nasal bones project into the frontal in the form of two large convex lobes. In the ass the lobes are smaller, and have a less pronounced convexity (Fig. 7): in some individuals, indeed, they are bounded by an almost straight line. In the horse, consequently, the naso-frontal suture has the form of two fairly high arches, joined together in the middle line of the skull; whereas, in the ass, it is in the form of two almost straight lines meeting in the middle line at an angle. For the purpose of demonstrating the shape of the nasal bones by measurements, I decided to take their width and length. I made three measurements of their width: first, from the posterior and most external point on the naso-lachrymal suture (Figs. 6 and 7, *a*); the second, from the anterior and most external point on this suture (Figs. 6 and 7, *b*); and the third from the point of contact of the intermaxillary and nasal bones (Figs. 6 and 7, *c*). The length of the bones was measured in two directions. The first diameter was taken from the highest point on the naso-frontal suture to the apex of the nasal bone (Figs. 6 and 7, *d* to *e*); and the second along the entire length of the suture between the two nasal bones (Figs. 6 and 7, *f* to *e*). The figures thus obtained exhibit fairly marked differences between the skulls of the horse and of the ass. In the horse the distance between the posterior ends of the two naso-lachrymal sutures is greater than that between their anterior ends; that is to say, the posterior part of the nasal bone of the horse narrows anteriorly. In the ass the reverse is the case; that is, the nasal bones increase in width. This condition was found to be very constant in the skulls of eleven horses and five asses. In only one horse's skull (No. 2,306) was there an equality in the two diameters; whereas, in the other specimens there was a difference of from 5 to 10 mm. In the ass the more anterior measurement was greater than the posterior by from 5 to 8 mm. In this character, the representative specimens of *E. prjevalskii* were in complete agreement with *E. caballus*. As in regard to Franck's index, so here the Asiatic wild ass shows variations. The majority of the skulls examined (eight out of twelve) gave the same proportion between the two diameters as does the skull of the horse; the others resembled the ass. In one specimen of *E. hemionus* the two distances were equal.

In this region, the skull of the hinny *(E. hinnus)* is remarkable. Transverse measurements of the nasal bones, such as have been discussed above, give figures which indicate an exaggeration of the ass type of skull. The anterior transverse measurement exceeded the posterior by some 14 mm.; whereas, in the ass, the difference did not exceed 9 mm. Then, the difference between the length of the nasal bone from the highest part of the naso-frontal suture and the length along the inter-nasal suture reached 49 mm.—a very unusual figure for the horse. Again, the conformation of the lachrymal bone and the shape of the naso-lachrymal suture were of the ass type. Therefore, the skull of the hinny is intermediate between the skulls of the horse and the ass; inasmuch as the difference between the transverse measurement from the anterior and posterior ends of the two naso-lachrymal sutures resembles that common in the ass, while the form of the posterior part of the nasal bones and of the naso-lachrymal suture correspond to the horse.

In shape, the post-orbital process of the frontal bone (processus zygomatici ossis frontalis) is three-sided in the horse and flattened in the ass. Essentially, however, the process, in both the horse and the ass, consists of a bony plate, one edge of which curves downwards. Upon the degree of this curvature depends the greater or lesser three-sided character of the process. I am convinced that the shape of the post-orbital process is in no way distinctive of the various species of *Equus*, and shall, therefore, discuss it no further.

The basilar length and the length of the vertex of the skull of *E. prjevalskii* varied very little. In five specimens the shortest basilar length was 472 mm., and the longest 495 mm.—a difference not exceeding 5½ per cent. of the total length. This is much less than in the onager, where the difference amounted to 10 per cent. In *E. prjevalskii* the average basilar length of the skull was 483 mm.; in the onager it was 453 mm. The amount of variation in this diameter in the domestic horse is considerably greater. The smallest skull of the ordinary horse which I measured had a basilar length of 428 mm. (No. 4,049); while the skull of a Kirghiz horse had a length of 498 mm. This difference—one of 15 per cent.—was quite naturally to be expected when domesticated horses were being dealt with. Among the skulls examined was one of a Somaliland ass *(E. asinus* var. *somalicus)* of an unusually large size. The enormous size of the head of the Somaliland ass is well known. In the ass the basilar length varied from 362 to 373 mm.; but in the Somaliland ass it was 450 mm. The variation in the length of the skulls of individual asses may be very considerable, and is probably due to racial differences. In this connection it may be mentioned that Nehring [*] gives measurements of the skull of a Maltese donkey which had the enormous length of 504 mm.; while the length of the skull of the domestic ass *(E. asinus)*, according to the same writer, varies from 353 to 393 mm. Here is evidently a racial peculiarity.

In the skull of *E. prjevalskii* the length of the vertex varies even less than does the basilar length; namely, from 528 to 547 mm.—corresponding to less than 4 per cent. of the greatest length. In the Asiatic ass the range of variation is greater, namely, from 487 to 529 mm. In the domestic horse, if we include the skulls of sub-fossil horses, the range was still greater, namely, from 506 to 565 mm. The greatest length was reached by the skull of a Kirghiz horse (No. 1,988), an animal distinguished by a very large and somewhat convex head. In *E. prjevalskii* the average length of the vertex of the skull was 539.8 mm.; in the onager 509 mm.; in the kiang 524 mm.; and in the domestic horse 524 mm. From this it is evident that the Prjevalsky horse has a very large head; a peculiarity all the more striking because of the circumstance that the body is smaller than that of many breeds of domestic horses.

The relation of the length of the base of the skull to the length of the vertex depends upon the degree of curvature of the skull as a whole, and is expressed by the difference between the length of the vertex and the basilar length. In the Prjevalsky horse this difference is subject to relatively little variation; namely, from 52 mm. (No. 3,074) to 62 mm. (No. 3,094). In this respect the Prjevalsky horse resembles the Asiatic ass, in which the difference varied from 51 to 70 mm.; while in the domestic horse it ranged from 37 to 67 mm. The maximum difference (67 mm.) belongs to the extremely convex skull of the Kirghiz horse; so that, if we exclude this specimen, the variation in the domestic horses is only from 37 to 57 mm., and, therefore, does not exceed the range in the Prjevalsky horse and in the Asiatic ass.

In *E. prjevalskii*, the average frontal width was 206 mm.; and the range of variation was from 201 to 212 mm., which is not very great. The broadest forehead (212 mm.) was found in a specimen, sent by Schischmareff from Kobdo, in which it is remarkable that the skull as a whole is by no means a long one. In frontal width *E. prjevalskii* differs in a well marked manner from *E.*

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[*] Op. cit. p. 103.

caballus, and more nearly approximates the Asiatic ass, in which the average width of forehead amounted to 206 mm. The width in the several skulls of *E. hemionus* varied from 198 to 209 mm. In the domestic horse, as Nehring has shown, the variation in the width of the forehead is very great when measurements are made of skulls taken from a number of different breeds. Nehring measured forty skulls of *E. caballus*, in which, according to his tables, the frontal width varied from 175 to 255 mm. Of the forty skulls, the width of the forehead was over 230 mm. in six specimens; and the average for the whole number was 218 mm. This clearly shows that the absolute figures of measurements of the skull of the domestic horse are of little value when they are to be compared with those obtained by measurement of the skulls of wild species of *Equidæ*. In the constancy of its frontal width, the Prjevalsky horse takes first place among wild species.

The ratio of the frontal width to the basilar length, and to the length of the vertex of the skull, indicated in Nehring's Indices I. and II., and the position of the eyes (Index III.) are fairly stable in *E. prjevalskii*. Index I. varies from 232.6 to 244.9; but the latter figure refers to a skull which was remarkable in having an exceedingly narrow forehead. In general, I can agree with Czerski, who says that *E. prjevalskii* belongs to that order of horse in which the forehead is of medium width; or, in other words, where Index I. varies from 226 to 240. In the collection in the Zoological Museum is the skull of a ten-months' foal (Skin, No. 3,072), which assuredly belongs to the type of horse with a broad forehead, since it has an Index I. of 212.5. As I have only this single skull of so young an animal, I cannot venture to assert that the Prjevalsky horse, at an early age, has a broad forehead like the ass, which becomes of medium width later on. I must point out, however, that this skull differs in a remarkable manner from all the other skulls of *E. prjevalskii*, in which the first frontal index is of conspicuous constancy. In regard to the frontal index (Index I.), the Prjevalsky horse occupies an isolated position among the various species of *Equus*. The index is greater in *E. prjevalskii* than it is in the Asiatic ass and in the African ass; that is, the forehead is of moderate width. In the asses, on the other hand, the forehead is broad, except in some rare specimens—mostly young animals—of the Asiatic ass where the frontal index exceeds 225. In one specimen, indeed, I found an index which decidedly approached that of the narrow-forehead type of skull (239 !). Those Prjevalsky horses in which the index is fairly constant (234 on an average) resemble, so far as the forehead is concerned, the breeds of the domestic horse in which the forehead is of medium width.

All that has been said above regarding the first frontal index (Index I.) is also applicable to the second index (Index II.), which, in the Prjevalsky horse, varied from 255.7 to 270. In this respect, the eighteen to twenty months' old foals fully resembled the adult animals which had already changed their teeth. The ten-months' old foals possessed the smallest second frontal index. In the Asiatic ass the index was smaller than in the Prjevalsky horse; and in the donkey it was still smaller, as might be expected from the consideration of Index I.

In the accompanying tables are given measurements of the brain-region of the skull made in various directions. In the first instance, the skull was measured along Nehring's ocular line; and thus the position of the orbital cavity, which is closely related to the size of the cranium, was defined. Next, the width of the cranium was measured at three different levels: (1) between the superior margins of the two external auditory meati; (2) above the zygomatic processes of the temporal bones; and (3) behind the orbital cavities. Then, the distance between the posterior end of the inter-nasal suture and the occipital crest was ascertained, and this distance referred to the length of the vertex of the entire skull, taken as 100. What I shall call Index IV. was thus computed. Finally, the height of the cranium was measured from the lower margin of the foramen magnum to the occipital crest. In this way the dimensions of the cranium were ascertained in all directions. The relation which the posterior ocular line (distance from the occipital crest to the most external point on the posterior margin of the orbital cavity) bears to the anterior ocular line (distance from the most external point on the posterior margin of the orbital cavity to the base of the middle incisors) is shown in the so-called *Ocular Index*, or Index III. of Nehring.

The width of the cranium of *E. prjevalskii* showed the following variations. The diameter between the external auditory meati varied from 104 to 115 mm. in young animals, and from 112 to 120 mm. in adults. In this diameter the skull of the Prjevalsky horse exceeded not only the skull of the ass, in which (with the exception of the Somaliland ass with a relatively enormous head) the width varied from 100 to 109 mm., but also that of the Asiatic ass, where it did not exceed 117 mm. In respect of the width of the cranium between the auditory meati, as well as in other features, *E. prjevalskii* most closely resembled *E. caballus.*

Anteriorly, the skull of the Prjevalsky horse narrows somewhat, but its width is always greater than in any other species of *Equus.* In full-grown Prjevalsky horses, the width of the cranium on a level with the zygomatic processes of the temporal bones, ranged from 104 to 110 mm.; whereas, with the exception of a single specimen, it did not exceed 109 mm. in the Asiatic ass. Indeed, in the majority of twelve asses' skulls, it was found to be from 101 to 103 mm. In the African ass, the maximum width of the skull in this region amounted to 102 mm.; but in the majority of specimens it did not exceed 89 mm. In fifteen skulls of the domestic horse, the width reached 108 mm. in two specimens only, and in the majority it varied from 97 to 108 mm.

Similar remarks are applicable to the narrowest width of the cranium (taken behind the orbital cavities). In this also *E. prjevalskii* takes first place; since, in this species, the narrowest part of the cranium (measuring from 87 to 94 mm.) was wider than the corresponding region of the donkey's skull, where the minimum width was 66 mm., and the maximum 84 mm. In the Asiatic ass, the diameter measured from 73 to 86 mm.; and, in the domestic horse, from 80 to 87 mm. Therefore, the cranium of the domestic horse resembles that of the Asiatic ass; and its maximum narrowest width corresponds to the minimum narrowest width of the skull of *E. prjevalskii.* An examination and comparison of the foregoing figures justifies the conclusion that the Prjevalsky horse has the broadest cranium of any member of the genus *Equus.*

The length of the cranium (from the posterior end of the internasal suture to the occipital crest) is greater in *E. prjevalskii* than in either the donkey or the Asiatic ass. It measured from 241 to 255 mm.; while, out of twelve skulls of the Asiatic ass, only one attained the length of 254 mm., and in the others it did not exceed 245 mm.—186 mm. being the minimum. In the skulls of the donkey (with the exception of the Somaliland ass, which gave the enormous length of 261 mm.), the length of the cranium was not greater than 226 mm. In the domestic horse the cranium varied greatly in length; the maximum being 250 mm. If the relatively small variations in the length of the cranium of *E. prjevalskii* be taken into account, we must admit that in this respect also it takes first place among the *Equidæ.*

When the length of the cranium is compared with the length of the vertex of the entire skull (as indicated in Index IV.), the skull of *E. prjevalskii* differs from the skulls of the other *Equidæ* in the possession of a remarkably short cranium. In the Prjevalsky horse, the length of the cranium was to the total length of the vertex as 100:211-227. That is to say, the cranium forms considerably less than one-third of the total length of the skull. In the Asiatic ass the relation was as 100:195-213; and in the donkey as 100:195.5-218. The domestic horse resembled the wild horse more closely, since the relative length of the cranium was as 100 : 210-234. Therefore, although the Prjevalsky horse and the domestic horse have the greatest absolute cranial length, nevertheless, in proportion to the total length of the skull, the cranium is least developed in these animals.

The height of the skull, as determined by the distance from the lower margin of the foramen magnum to the occipital crest, was greater in *E. prjevalskii* than in any other member of the genus, and varies from 102 to 110 mm. In the Asiatic ass the maximum height amounted to 97 mm. only, and consequently did not reach the minimum of *E. prjevalskii.* In the donkey the height of the cranium was even less; its maximum being only 90 mm. In the Somaliland ass alone did the height amount to 100 mm. Among the representatives of *E. caballus*, only the Tarpan (No. 521) exceeded the Prjevalsky horse in the height of the cranium; and in this animal I obtained my maximum measurement, namely, 117 mm.

The foregoing figures lead to the conclusion that the cranium of *E. prjevalskii* is very largely developed in all directions. If its relative length (as compared with the total length of the skull) is less than in other species, this is explained by the very considerable length of the skull as a whole, which is exceeded only in some domestic horses and in the zebra.

The position of the orbital cavities, determined by Nehring's so-called "ocular lines," and shown by his ocular index (Index III.), does not always agree with Index IV. This might be expected *à priori*, since Index IV. refers to the cranium. In *E. prjevalskii*, the ocular index varied within very narrow limits, namely, from 190 to 197; or, if one of the young skulls be included, from 190 to 199. In the Asiatic ass, on the contrary, the variation was very marked, namely, from 183.5 to 201; and in the African ass it was still greater—from 155 (in the foal, No. 519) to 182.4. In the domestic horse the range was less—from 174.4 to 195.9. In consequence of its great variability, the ocular index cannot possess so great an importance in systematic classification as do Indices I., II. and IV. On this account Czerski * has already pointed out that the ocular index is much less important than Indices I. and II., and has proposed to replace it by a facial index, as before mentioned.

The extent of the face was determined (1) by its length from the incisors to the posterior end of the inter-nasal suture, and by Index IV., which gives the proportion of the facial length to the length of the vertex of the skull as a whole; (2) by its breadth

* Op. cit. p. 378.

in the regions of the zygomatic ridges and of the incisor teeth; and (3) by its height as measured from the middle of the internasal suture to the last molar tooth.

The face in the Prjevalsky horse is long, and bore a ratio to the length of the vertex of the skull as 100:175-179.7. The variation in the absolute figures of the measurements are much more important than the relative figures of Index IV. In *E. prjevalskii* the length of the face varied from 295 to 317 mm. In the Asiatic ass, the maximum length was not greater than 298; and Index IV. revealed a proportion of 100:193; thereby indicating a much greater variation than in the Prjevalsky horse. The Somaliland ass, endowed with a face of extraordinary length (289 mm.), forms an exception to the asses in general, in which the face is quite short. The maximum facial length in the asses' skulls amounted to 239 mm.; and Index IV. varied from 100:174 to 100:187. Variations in the index were much less marked in the domestic horse, and were within 100:172 and 100:180.

The width of the face is greater in *E. prjevalskii* than in any other species of *Equus*. The minimum in grown-up animals was 180 mm.; and the maximum, 190 mm. Although the facial width, on a level with the zygomatic ridge, amounted to as much as 195 mm. in other species, as for instance in the Asiatic ass, this was exceptional. In the majority it did not exceed 172 mm.; that is, it did not attain to the minimum width of the face of *E. prjevalskii*. It is noteworthy that an onager from the Desert of Gobi (No. 515), which had the greatest facial length, was by no means conspicuous for the width of its face. The width of the face in the region of the incisor teeth—spoken of, for the sake of brevity, as the width of muzzle in the accompanying tables—was very characteristic in the Prjevalsky horse. It was considerably greater than in the Asiatic and African asses, and varied from 70 to 76 mm. In this respect, the skull of *E. prjevalskii* resembles the skull of the domestic horse, in which the diameter ranged from 61 to 75 mm. In the skulls of the onager, the maximum nasal width was 67 mm.; and in the African ass it did not exceed 55 mm., except in the Somaliland ass, where it attained to 66 mm.

An investigation of the height of the face—as measured from the posterior part of the last molar tooth to the middle of the inter-nasal suture—demonstrated that it is a comparatively valueless aid to classification. In the Prjevalsky horse it measured from 133 to 138 mm.; in the onager from 124 to 139 mm.; in the donkey from 102 (No. 1,136) to 130 mm.; and in the domestic horse from 134 to 150 mm. On account of these great variations —especially in the onager, donkey and domestic horse, and to a much less extent in *E. prjevalskii*—it is not possible to draw conclusions regarding peculiarities of the skull of different species from the height of the face.

As Poliakof * has already demonstrated, the lower jaw of *E. prjevalskii* is very different in shape from that of the donkey and the Asiatic ass, and resembles much more closely the mandible of the domestic horse. Its inferior border is smooth and straight (Fig. 8); whereas, in the donkey, it is curved and furnished with prominences (Fig. 9). The fine illustrations contained in Poliakof's monograph reveal, in the clearest manner, this difference between the mandible of the ass and that of the horse. I can fully confirm Poliakof's statements, and regard the peculiarity as being a very constant feature by which the skull of the donkey may be distinguished from the skull of the horse. I can only add that, as shown in Poliakof's drawing, between the horizontal and vertical rami of the mandible of the donkey there is a very characteristic indentation; and that the inferior border of the jaw is much thicker in the ass than in the horse. These features are so constant that, with their aid, one can, with a fair amount of certainty, decide whether a given skull belongs to a horse or to a donkey.

The dimensions of the lower jaw, the length of the diastema between the incisor and cheek teeth, and the length of the series of cheek teeth are not all valuable as distinguishing characters. The mandible of *E. prjevalskii* measured from 421 to 436 mm. in length, and was, therefore, longer than the corresponding bone in the other species. A similar length occurred only very exceptionally in the Asiatic wild ass (for example in No. 217, the only skull of *E. hemionus* in which the lower jaw reached a length of 435 mm.). In none of the domestic horses measured by me was the length of the jaw so great as this (the maximum was 434 mm.); although in heavy draught horses (Brabant breed), measured by Nehring, the bone attained a length of 515 mm. in a skull with the enormous length of vertex of 628 mm. Among the wild species of the genus, *E. prjevalskii* is distinguished by the possession of the longest lower jaw.

Although, in individual cases, the height of the lower jaw showed considerable variation, it was found to be a distinguishing feature of the skull of the Prjevalsky horse. In full-grown animals, it varied from 206 to 234 mm. So great a height was not found in any skull of the Asiatic ass (maximum 215 mm.), nor in the African ass (the lower jaw of the Somaliland ass alone reached a height of 214 mm.). Only in the skull of the domestic horse, and only in a few of those measured, did the height of the jaw exceed

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* Op. cit. p. 12.

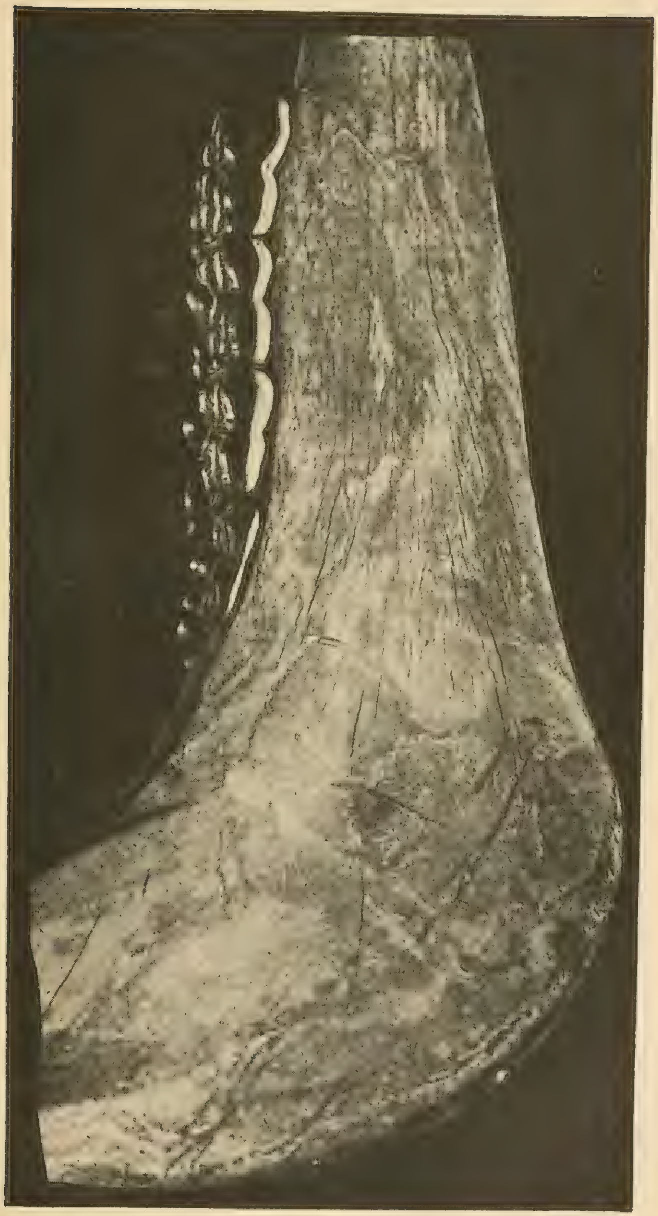

Fig. 8.—Mandible of *Equus Prjevalskii.*

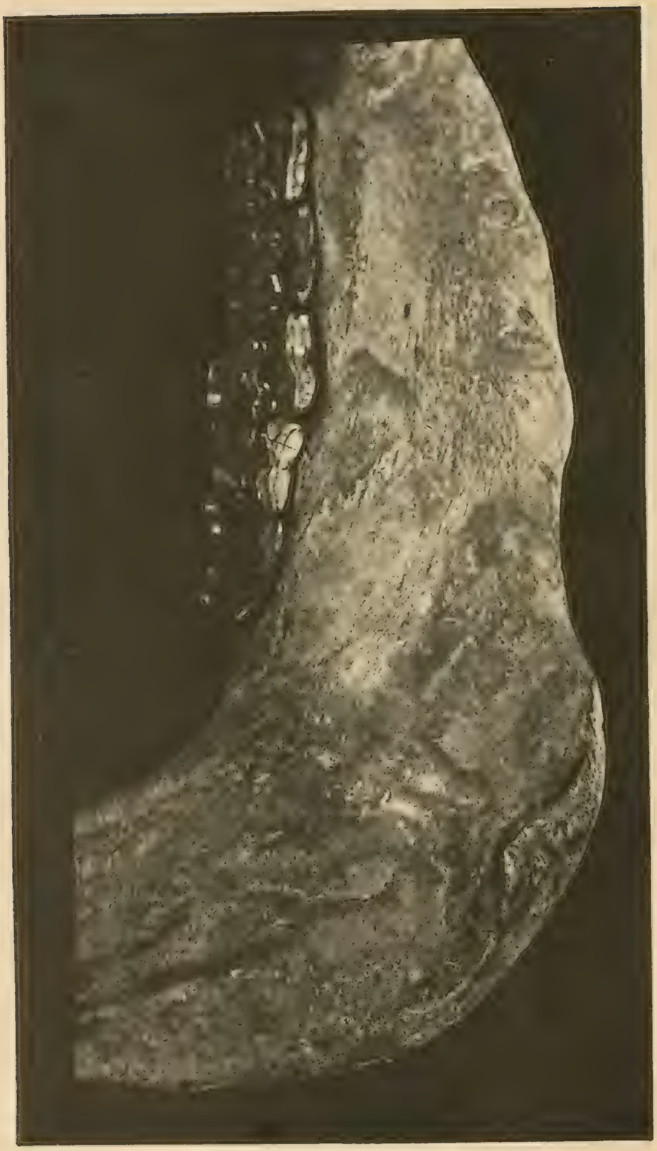

Fig. 9.—Mandible of the Ass (*Equus Asinus*).

the maximum found in *E. prjevalskii* (*e.g.*, Nos. 988 and 4,051 had a mandibular height of 238 mm.). Of course heavy draught horses, in which, according to Nehring the height may be as much as 281 mm., were not included.

Poliakof* remarks that, in the length of the diastema, the Prjevalsky horse resembles the domestic horse; but that, on the other hand, it is very different from the donkey, in which the interdental space is shorter than in the horse. In general this remark is correct if the comparison is confined to the domestic horse and the donkey *(E. asinus* and *E. tæniopus);* but the results are somewhat different if the Asiatic ass is included in the comparison. In the Prjevalsky horse, the diastema in the upper jaw measured from 77 to 90 mm.; and in the lower jaw from 74 to 92 mm. In the onager and the kiang, the length of the diastema was very little different; as, in the upper jaw it varied from 76 to 95 mm.; and in the lower jaw from 68 to 92 mm. A minimum of 68 mm., however, must be taken as exceptional, and 76 mm. should be substituted for it. This being done, the difference between the Prjevalsky horse and the onager is very slight. In the comparison of the skull of a donkey with one of the horse, the difference in the length of the interdental space will be found to be very pronounced, and can, therefore, be used as a diagnostic feature. In the donkey, the diastema of the upper jaw measured from 70 to 90 mm.; the maximum being in the remarkably large skull of the Somaliland ass. In the lower jaw the length was from 66 to 82 mm. These figures do not differ very widely from those of the Prjevalsky horse. In the domestic horse, however, the length of the diastema in the upper jaw was from 76 to 108 mm.; and in the lower jaw from 80 to 99 mm. To this should be added that a length of 76 mm.—which is exceptionally small—appeared only once among the measurements of fifteen skulls. Consequently, so far as the diastema is concerned, *E. prjevalskii* resembles the Asiatic ass, and even the African ass, more closely than it does the domestic horse.

The Prjevalsky horse possesses a very high skull; but the variations in its height—from 246 to 300 mm.—are very great. Similar variations were also found in the skulls of the onager, where the minimum height was 248 mm., and the maximum 297 mm. Consequently, in height of the skull, *E. prjevalskii* approximates the Asiatic ass very closely. Differences were greater in the other asses, and amounted to 89 mm. (minimum, 200 mm.; maximum, 289 mm. in the Somaliland ass). In domestic horses, the maximum height was 318 mm.; and the minimum 274 mm. (in a

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* Op. cit. p. 12,

Crimean tarpan, No. 521). With such great variations, it is very difficult to regard the height of the skull as having diagnostic value. Nevertheless, by comparing the maximum and minimum in all the species of *Equidæ*, the conclusion is arrived at that, in this respect, *E. prjevalskii* resembles the donkey and the wild ass more closely than the domestic horse.

By way of summary, the following conclusions with regard to the skull of *E. prjevalskii* may be stated:

(1). In *E. prjevalskii*, Franck's index resembles that of the skull of the horse, and is different from the same index in the ass.

(2). The form of the naso-frontal and naso-lachrymal sutures is the same as in the skull of the horse. Measurements of the naso-frontal region also point to the relationship of *E. prjevalskii* with the domestic horse, and not with the asses.

(3). The form of the post-orbital process of the frontal bone furnishes a feature of very doubtful diagnostic value.

(4). The Prjevalsky horse has a very large head. The average length of the skull exceeds that of other species of the genus.

(5). From the frontal width, *E. prjevalskii* may be classed among the horses with a forehead of medium width; although skulls are met with of the broad or narrow forehead type.

(6). The size (width, length and height) of the cranium of *E. prjevalskii* exceeds the dimensions of the cranium in other species.

(7). *E. prjevalskii* has a very long face, the dimensions of which are greater than those of the Asiatic ass and the other asses. The ratio between the length of the face and the length of the vertex of the whole skull (Index IV.) in the Prjevalsky agrees with the ratio in the domestic horse, but differs from that of the Asiatic ass and the other asses.

(8). The nasal width is greater than in other species of *Equus*.

(9. In shape, the lower jaw of *E. prjevalskii* resembles the corresponding bone of the horse, and differs from that of the asses. In its dimensions also, it closely resembles the lower jaw of the horse.

(10). In the length of the diastema and in the height of the skull, *E. prjevalskii* more closely resembles the Asiatic ass than the horse.

From the consideration of the foregoing craniometric features, we may conclude that the Prjevalsky horse belongs to a special and separate type, which, however, is more closely allied to the domestic horse than to the ass.

THE TEETH.—In general, the teeth of all the horse tribe (the genus *Equus* in the wider sense) show great similarity as regards their form and the arrangement of the tissues of their wearing-surfaces. For this reason, no constant specific characters can be cited by which the teeth of different species can be distinguished. In the incisor teeth, the degree of narrowing from the wearing surface towards the base of the tooth has been used as a character by which the oriental may be distinguished from the occidental horse (Wilckens); but Czerski has demonstrated its unreliability. According to Franck, the folding of the enamel of the cheek-teeth serves to distinguish not only the above races of the horse, but also the ass (with straighter enamel folds) from the horse (in which the folds are more complicated). But this also, according to Nehring, is not constant. Concerning the relation of the length of the cheek-teeth to their breadth as a further distinction between the horse and the ass, I shall speak later.

Referring to the teeth of fossil horses, Nehring says truly that a comparison of the enamel folding can only be of value when the cheek-teeth are in a state of moderate wear. I have confined my attention to such teeth.

The incisors of *E. prjevalskii* (I consider adult animals only) are distinguished from those of other horses by their considerable size, as the following table shows:

Table of Measurements of the Incisors of Equus Prjevalskii.

		Upper Teeth.		Lower Teeth.
		Length.	Breadth.	
No.		mm.	mm.	mm.
5,212	I_1	33	17	15
	I_3	22	21	17
5,216	I_1	32	13	—
	I_3	32	18	—
5,214	I_1	35	18	16
	I_3	27	18	16
5,213	I_1	28	15	12
	I_3	29	17	14

These dimensions show no essential differences from those obtained by measurement of the teeth of the domestic horse and the onager.

The length of the diastema between the incisor and cheek-teeth varied in the Prjevalsky horse from 77 to 90 mm. Although the diastema of one specimen of onager now before me measures 95 mm., it is generally much shorter in this animal; and it can be stated, on the basis of averages, that the diastema in *E. prjevalskii*, on account of its marked length, comes nearest to that of the domestic horse, in which it reached 108 and 109 mm. in specimens I have examined.

E. prjevalskii, in common with the other species of *Equus*, possesses, in youth, an anterior (first) premolar tooth in addition to the ordinary molars and premolars. This interesting tooth, inherited from the ancestors of the horse, is never replaced by a permanent tooth in the modern horse. I have found it in all the young skulls of the Prjevalsky horse (Nos. 5,211, 5,212, 5,215 and 5,214), and always in the upper jaw. In all the skulls of horses, asses and onager examined, I have only once found this tooth in the mandible, and then in a young ass (No. 519). Nehring * states that a first premolar is not seldom present in the lower jaw of the domestic horse. In ten out of fifty-seven skulls examined by him he found it on both sides of the upper and lower jaws. In *E. prjevalskii* the tooth is of insignificant size—from 8 to 11 mm. in length, and from 5 to 9 mm. broad—pointed at its apex; placed very close in front of the next premolar; and pushed somewhat inwards. I have not found it in any skulls in which the temporary teeth have been replaced by the permanent dentition.

The length of the series of cheek-teeth (Fig. 10) of *E. prjevalskii* measured from 170 to 185 mm. in the upper jaw, and from 167 to 186 mm. in the lower jaw. In comparison with the other equine species this length is striking; it exceeds that of the domestic horse, the donkey and the Asiatic ass; and fails to equal that of *E. grevyi* alone. That the conspicuous length of the series depends upon the considerable dimensions of the individual teeth is shown by the following table:

Table of Measurements of the Cheek-teeth of E. Prjevalskii.

A. Upper Teeth.

	No. 5,216.		No. 5,212.		No. 5,213.		No. 5,214.	
	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.
P_2	37	25	40	25	41·5	28	40	28·5
P_3	29	29	29	30	28	30	31·5	31
P_4	27	29	27·5	30	26·5	30	30	30·5
M_1	21	23	25	28·5	24·5	29	26·4	30
M_2	21·5	22·5	25	28·5	24·5	28·5	26·5	28
M_3	30	23	28.5	25	32	24	28·5	24·5

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* A. Nehring. Ueber den sog. Wolfszahn der Pferde im Hinblick auf die genealogische Zusammensetzung der fossilen und lebenden Equiden.—*Sitzungsbr. der naturforschenden Freunde zu Berlin.* No. 3 and 4.

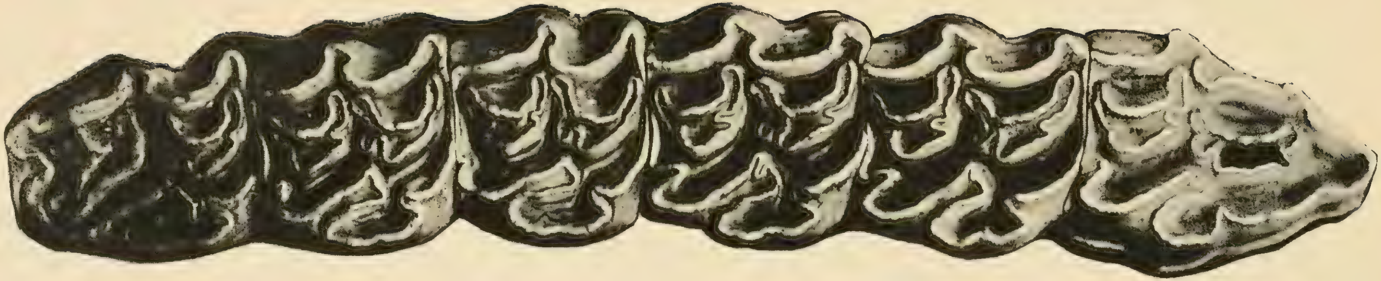

Fig. 10.—Series of upper cheek teeth.

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B. Lower Teeth.

	No. 5,216.		No. 5,212.		No. 5,213.		No. 5,214.	
	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.
P_2	32·5	16·5	34·5	18	34	17·5	34	17
P_3	27·5	15·5	29·5	19	29	19	31·5	17
P_4	27·5	15·5	29	19·5	27	19	31	18
M_1	21·5	15	25·5	18·5	24	18	26·5	18
M_2	23·5	12	25·5	17	25·5	17	29	17
M_3	32	12	31·5	14·5	33	14·5	35	13

A glance at the above table shows that the relation between the breadth and length of the cheek-teeth of the Prjevalsky horse is the same as in the domestic horse, the Asiatic ass and the African ass. In all species of the genus *Equus*, the relation between the length and breadth of the premolars and molars of the upper jaw is quite different from that of the lower teeth. Only in P_2 and M_3 is there a complete correspondence in this respect in the two series of teeth: the length considerably exceeding the breadth. This is explained by the circumstance that the growth of P_2 forwards and M_3 backwards meets no resistance, since it is not restrained by a neighbouring tooth. A certain amount of variation appeared in the relation between the length and the breadth of the upper P_3. In No. 5,216, the length and breadth were equal; whereas, in No. 3,092, the length slightly exceeded the breadth. In the other premolars and molars of the upper jaw the breadth exceeds the length: in the mandible the relation is reversed. With the exception of P_2 and M_3, in which there is the same relation of length to breadth as in the corresponding teeth in the upper jaw, the breadth of all the teeth in the lower jaw is greatly surpassed by the length.

Precisely the same relation is met with in the domestic horse, in the Asiatic ass, and in the donkey, as is demonstrated in the following table. In order to avoid a needless multiplication of tables, I give here the measurements taken from one skull only of each of the three species. These correspond in all respects to the teeth in the remaining skulls in the collection.

Table of Measurements of the Cheek-teeth of the Domestic Horse, the Asiatic Ass, and the Donkey.

A. Upper Teeth.

	E. caballus. No. 5,229.		E. hemionus. No. 511.		E. asinus. No. 1,136.	
	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.
P$_2$	35	22	36	25	27	29
P$_3$	23	25	30	26	21	21
P$_4$	22	25	26	26	20	23·5
M$_1$	20	23	24	25	19	22
M$_2$	21	23	25	25	17·5	18
M$_3$	26	21	25	20	18	17

B. Lower Teeth.

	E. caballus. No. 5,229.		E. hemionus. No, 511.		E. asinus. No. 1,136.	
	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.
P$_2$	28	14	32	16	22·5	11
P$_3$	24	18	27	17	22	15
P$_4$	22	18	26	16	20	15
M$_1$	22	17	24	14	18	14·5
M$_2$	22	16	26	13	18	12
M$_3$	28	15	27	12	22	10

From these tables it is manifest that the dimensions of the cheek-teeth, and the relation of the length of the wearing-surface to its breadth, are the same in all species of *Equus*, and, therefore, cannot serve as distinguishing features, as Franck assumed.*

Of much greater importance is another character mentioned by Franck, in the same communication, as being of service in the distinction of the teeth of the horse from those of the donkey. This is the smaller degree to which the enamel of the teeth of the ass are folded. The ass's teeth are also distinguished by the absence of the so-called "spur," a projection into the anterior-internal depression of the enamel (by which the anterior-internal pillar—Protoconus of Osborne—is separated from the posterior-internal pillar—Hypoconus). The difference, in this respect, between the molar teeth of the horse and the ass is clear from the drawings accompanying Franck's paper. The folding of the anterior and posterior crescentic ridges of enamel is much more sharply pronounced in the horse than in the ass. In this particular *E. prjevalskii* undoubtedly stands near to the domestic horse. Though the absence of the so-called "spur" is very clear in the donkey and the Asiatic ass, its presence and strong development are characteristic for neither *E. caballus* nor *E. prjevalskii*. Among the skulls in the collection of the Zoological Museum, the "spur" is distinct in No. 5,231 (a horse from the Derbet); but in all other skulls, on the contrary, it is either small or entirely absent. Among the skulls of the Prjevalsky horse, there is a very long fold, representing the "spur," in No. 5,218; in Nos. 5,212, 5,214 and 5,216, the fold is feebly developed; and, in No. 5,213, it is completely wanting.

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* Op. cit. p. 42.

THE VERTEBRAL COLUMN AND THE BONES OF THE LIMBS.—In contrast to the fairly large number of the skulls of *E. prjevalskii*, the Zoological Museum contains only one half-skeleton belonging to an animal, of about ten years old, received from G. E. Grum-Grjimailo. The skin belonging to the skeleton bears the number 3,092.

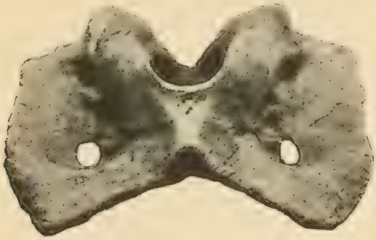

Fig. 11.—Atlas (ventral aspect).

An examination of the individual parts of the skeleton reveals the following particulars. I cannot compare the dimensions of the bones with those of the horse, because our horse skeletons are not fully developed.

THE VERTEBRAL COLUMN. THE FIRST CERVICAL VERTEBRA (ATLAS, Figs. 11 and 12) has the form of the same bone of the domestic horse. Its wings are broadened out posteriorly, and the difference in their width on a level with the anterior and posterior foramina amounts to 13 mm. In comparison with the dimensions of the wings, the length of the superior part of the arch is rather small. The fossæ beneath the wings are very deep. The tuberosity of the upper part of the arch (tuberculum posterior) is only feebly developed. Measurements according to Nehring's scheme give the following figures:—

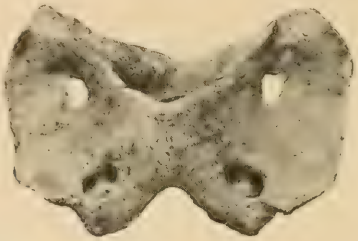

Fig. 12.—Atlas (dorsal aspect).

	mm.
Length of the upper part of the arch	39
Width of the wings on a level with the anterior foramina	129
Width of the wings on a level with the posterior foramina	142
Width of the articular surface for the occipital condyles	76
Width of the articular surface for the axis	85
Width of the anterior end of the neural foramen	34
Height of the anterior end of the neural foramen	27

THE SECOND CERVICAL VERTEBRA (EPISTROPHEUS. AXIS VERTEBRA, Fig. 13) is characterised by a fairly strong development of the odontoid process. The two roots of the transverse process, which in *E. caballus* are fairly widely separated from each other, are nearer together in *E. prjevalskii;* with the

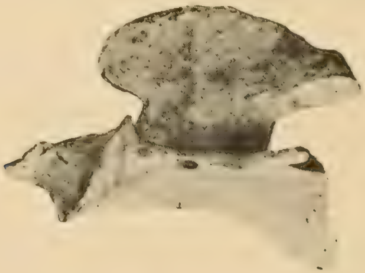

Fig. 13.—Axis (lateral aspect).

consequence that the depression is shallower and narrower than in the domestic horse. The anterior (cephalic) intervertebral notch is not converted into a foramen as in the case of the horse. It is noteworthy that in the Tarpan the foramen is present on the right, but on the left there is a notch.

The following are the dimensions of the axis vertebra of the Prjevalsky horse:—

	mm.
Length to the tip of the odontoid process	141
Height to the extremity of the processus spinosus	79
Height of the neural foramen...	55
Vertical diameter of the caudal end of the centrum	45
Greatest breadth of the centrum	45
Length of the processus spinosus	78
Breadth of the articular surface for the atlas	82
Greatest breadth of the transverse processes	90
Breadth of the articular processes	66

THE THIRD, FOURTH, FIFTH, SIXTH (Fig. 14) AND SEVENTH CERVICAL VERTEBRÆ.—I do not propose to give a description of each of these vertebræ, but will confine myself to the peculiarities of one of them, namely, the sixth. This vertebra presents all the characters by which the corresponding bone of *E. caballus* can be distinguished from that of the ass. The middle portion of the transverse process is higher than in the sixth cervical vertebra of the donkey, and is not curved so far backwards. The spinous process is of the same moderate height as in the horse's vertebra. The dimensions of four cervical vertebræ are given in the following table (the fifth vertebra was not measured because its spinous process was broken off). In the

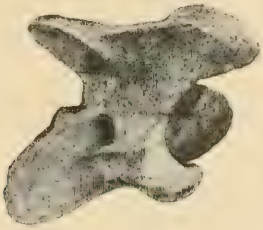

Fig 14.—Sixth cervical vertebra (lateral aspect).

skeleton of the Tarpan, the corresponding measurements were not undertaken :—

	Cervical vertebræ.			
	3rd. mm.	4th. mm.	6th. mm.	7th. mm.
Length of centrum	106	112	92	75
Width of anterior articular processes	81	75	80	80
Width of posterior articular processes...	76	77	80	80
Width of anterior part of transverse processes ...	84	68	79	106
Width of posterior part of transverse processes ...	116	116	101	106
Height of the vertebra to the extremity of the spinous process	78	84	70	68

THE THORACIC VERTEBRÆ.—The number of thoracic vertebræ is normal; namely, eighteen. The first vertebra (Fig. 15) has the characteristic attributes which distinguish the same bone of *E. caballus*, and by which it is differentiated from the corresponding vertebra of the donkey. Its spinous process is sabre-like in form, with fairly smooth surfaces. The anterior articular processes are wide, as in the horse, but the interval between the anterior and posterior articular processes is level and not convexly arched. This peculiarity distinguishes the first thoracic vertebra of *E. prjevalskii* from the same bone of the domestic horse and of the Tarpan. The eighteenth vertebra (Fig. 16) is only different from the corresponding bone of the domestic horse in that the articular depressions on the transverse processes are small. In general it closely resembles the type of the same bone of the domestic horse.

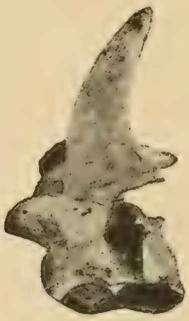

Fig. 15.—First thoracic vertebra (lateral aspect).

THE LUMBAR VERTEBRÆ.—*E. prjevalskii* possesses only five lumbar vertebræ. This number was considered by Franck to be peculiar to the skeleton of the donkey; but it is also met with in the horse, and is not now held to be a distinguishing peculiarity of any particular race of horse. In the ass and its hybrids, the number (five) is typical and constant. The first lumbar vertebra (Fig. 17) possesses a form intermediate between that of the domestic horse and that of the donkey. The anterior articular process is pointed at the end, and in this respect resembles the corresponding vertebra of the ass. In the horse, the process is rounded and has a broader end. The spinous process in the Prjevalsky horse is bounded by an even backwardly sloping line, which is not convexly curved as in the ass. Of the remaining lumbar vertebræ, the fourth and fifth have been injured and, therefore, are not suitable for comparison. The second and third show no outstanding peculiarities. These vertebræ were not

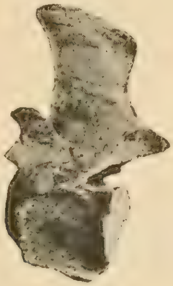
Fig. 16.—Eighteenth thoracic vertebra (lateral aspect).

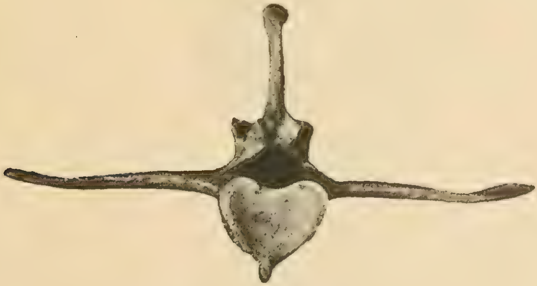
Fig. 17.—Lumbar vertebra (caudal aspect).

measured in the Tarpan. Their size in *E. prjevalskii* is as follows:—

	Lumbar vertebrae.				
	1st.	2nd.	3rd.	4th.	5th.
	mm.	mm.	mm.	mm.	mm.
Length of centrum	50	52	47	49	44
Width between the ends of the transverse processes	219	228	220?	—	161 max. 133 min.
Length of spinous process	65	66	68	64	—
Width of centrum	46	47	49	53	51
Width of articular processes	34	37	38	40	47

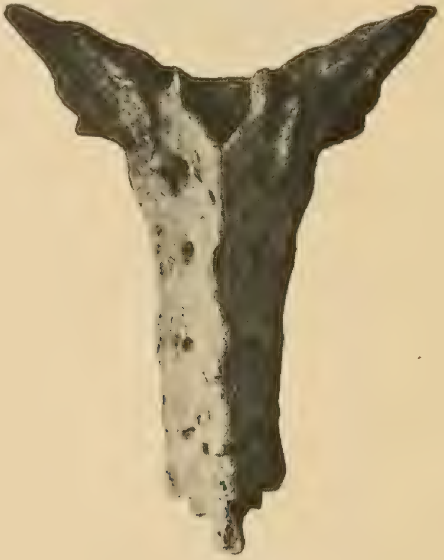

Fig. 18.—Sacrum (dorsal aspect).

THE SACRUM (Fig. 18), which consists of five fused vertebræ, entirely corresponds in form, in size, and in the arrangement of its spinous processes with the same bone of *E. caballus*. It is broad, on a level with the transverse processes of the first segment, and does not narrow so much towards the caudal end as it does in the ass (the difference in the total width of the first vertebra and that of the last segment is as 177 : 50 in *E. prjevalskii*, that is, the bone narrows about three and a half times; while in the ass the difference is as 130 : 29, that is, the narrowing amounts to more than five times). The spinous processes are all free. That of the last vertebra slopes much more backwards than it does in the horse or ass.

The measurements of the sacrum of *E. prjevalskii* and the Tarpan are as follows:—

	E. prjevalskii. mm.	Tarpan. mm.
Length of sacrum	186	? (broken)
Width between the ends of the transverse process of the first vertebra	177	179
Height of the spinous process of the first vertebra... ...	69	59
Height of the spinous process of the last vertebra	31	27
Width of the third vertebra on a level with the transverse processes	79	64
Width of the fifth vertebra on a level with the transverse processes	50	46
Distance between the articular processes of the first vertebra	30	32

THE SHOULDER GIRDLE.—The scapula (Fig. 19) is broad in

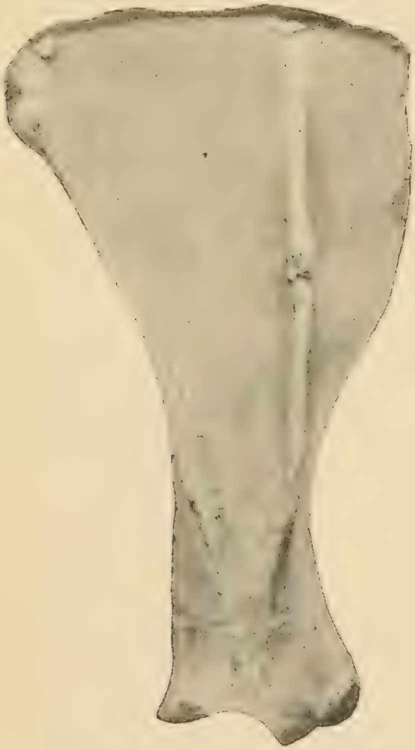

Fig 19.—Scapula (lateral aspect).

its upper part, and its anterior border is more convex than in the domestic horse. In this respect the scapula of *E. prjevalskii* has a close resemblance to that of the ass. The spine of the scapula (spina scapulæ), which runs down the outer surface, ends as in the horse. It is remarkable that the coracoid process (processus coracoideus) is only feebly developed, whereas, in the horse and the ass it is larger. The following table shows the measurements of the scapula :—

	E. prjevalskii. mm.	Tarpan. mm.
Greatest width of the upper part	178	163
Greatest width of the articular part	80	82
Length of the glenoid cavity	59	55
Width of the glenoid cavity	48	46
Greatest length of the scapula	321	307
Least width of the articular part	58	60

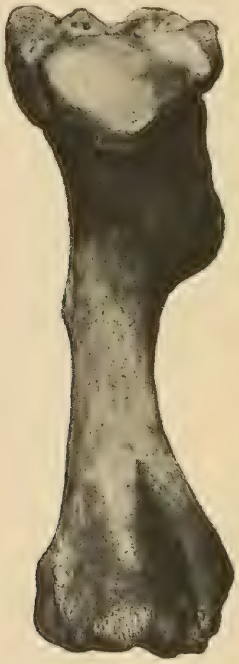

Fig. 20.—Humerus.

THE HUMERUS (Fig. 20) of *E. prjevalskii* is distinguished from that of the other *Equidæ* on account of its notable thickness.

The difference between it and the same bone of the Tarpan consists mainly in the form of the articular surfaces which are much the larger in the Prjevalsky horse. The elevations and depressions are very sharply defined and stand out conspicuously. The deltoid tubercle is very strongly developed, as it is also in the skeleton of the Tarpan which is preserved in the Zoological Museum. Its length reminds one mostly of that of the humerus of a pony, the dimensions of which are cited by Nehring.* In the following table are given the dimensions of the humerus of *E. prjevalskii*, the Tarpan and Nehring's dun pony side by side, in order to bring out clearly the differences between these animals:—

	E. prjevalskii. mm.	Tarpan. mm.	Pony. mm.
Greatest length	261	262	261
Length from the articular head to the distal articular surface	248	247	244
Greatest width of the upper part	91	86	82
Width of the articular head	70	61	63
Greatest width of the lower part	82	70	70
Width of the distal articular surface	74	66	67
Width at the narrowest part	36	35	31
Width of the anterior articular surface	101	92	91
Width of the deltoid tubercle	23	23	—

THE RADIUS AND ULNA (Fig. 21).—These bones in the Prjevalski horse are remarkable for the same peculiarities of dimensions as were found in the humerus. They are also much stronger than in those other species of *Equus* in which the humerus is of similar length. I shall again employ the before-mentioned pony of Nehring for the purpose of comparison. Although the forearm of *E. prjevalskii* is longer than that of the pony, the difference in the relative thickness is greater than the difference in length. In the following table the measurements of the bones of the forearm of *E. prjevalskii* and the pony are placed side by side:—

	E. prjevalskii. mm.	Pony. mm.
Greatest length of radius and ulna taken in their connected condition	380	364
Greatest length of the radius	312	298
Medium length of the radius	300	292
Length of radius on the outer side	297	284
Greatest width of the upper part of radius	80	73
Width of proximal articular surface of radius	72	66
Greatest width of radius below	73	64
Width of carpal articular surface of radius	63	56
Width of radius at its narrowest part	38	34·5

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* Op. cit., p. 124.

THE BONES OF THE CARPUS of *E. prjevalskii* are seven in number, namely, scaphoid, semilunar, cuneiform, pisiform, trapezoid, magnum and unciform; and possess no important peculiarities of form. So far as dimensions are concerned, some of them present quite insignificant deviations in comparison with

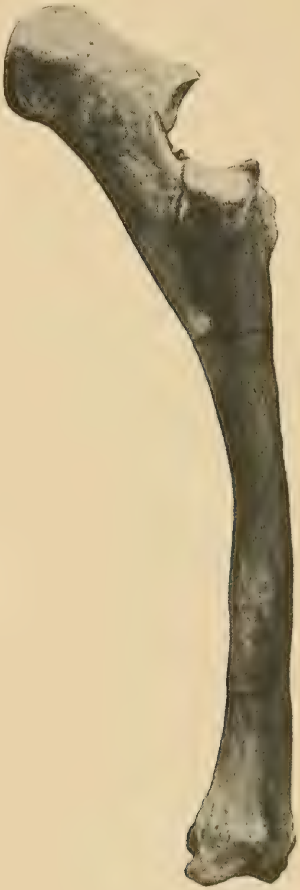
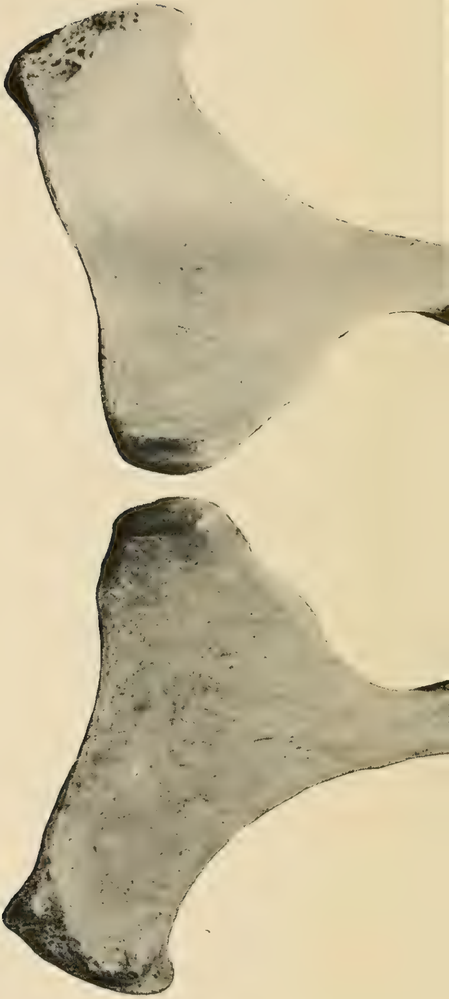


Fig. 21.—Radius and ulna.



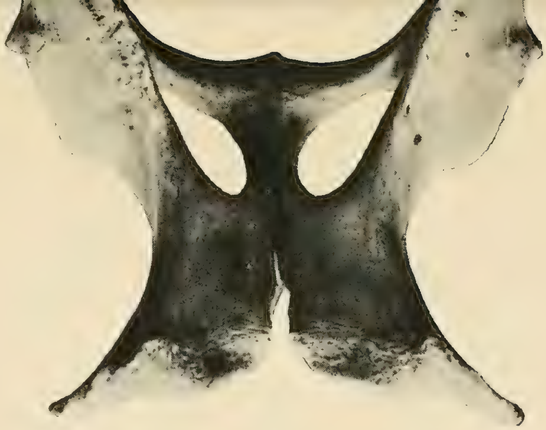


Fig. 22.—Innominate bones.

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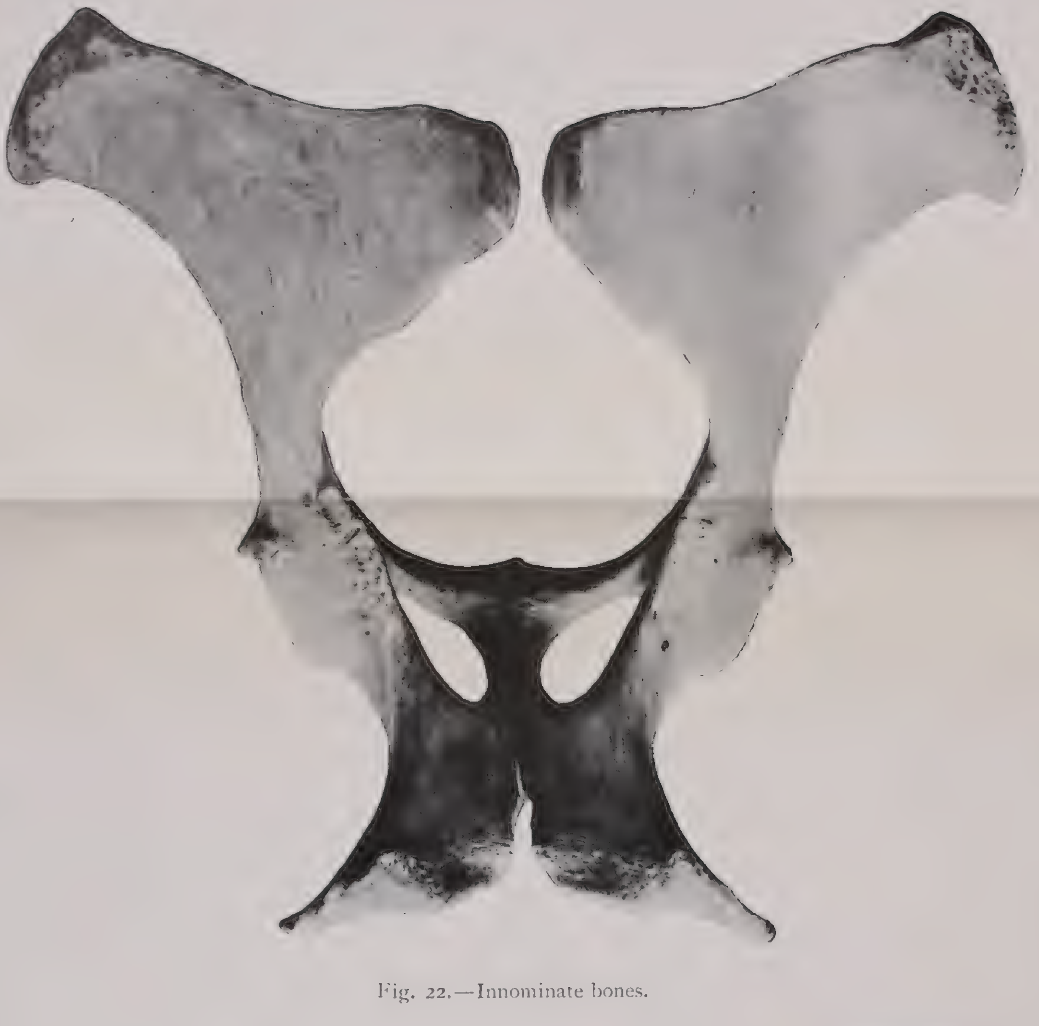

Fig. 22.—Innominate bones.

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the same bones of the Tarpan. Herewith are given the measurements of some of the bones:—

	E. prjevalskii.			Tarpan.		
	Length.	Width.	Height.	Length.	Width.	Height.
	mm.	mm.	mm.	mm.	mm.	mm.
Scaphoid	35	24	25	38	24	22
Semilunar	36	30	24	31	23	27
Cuneiform	26	17	22	25	14	23
Magnum	40	38	18	40	36	18

THE METACARPUS exceeds that of the Tarpan in its dimensions, and is remarkable generally on account of its conspicuous size as compared with the other bones of the same limb. In the Tarpan, for example, the humerus is somewhat longer than it is in *E. prjevalskii*, but, on the other hand, the metacarpus is much shorter. The rudimentary metacarpal bones are shorter in the Prjevalsky horse than in the Tarpan, as the following table indicates:—

	E. prjevalskii.	Tarpan.
	mm.	mm.
Greatest length	215	207
Length on the outer side	206	196
Width at the proximal end	48	47
Width in the middle	32	33
Width at the distal end	44	47
Length of the rudimentary metacarpal bones	132	136

THE FIRST AND SECOND PHALANGES differ only little from those of the Tarpan. In *E. prjevalskii* they are somewhat longer and narrower but the difference is insignificant, as the following measurements show:—

		E. prjevalskii.	Tarpan.
		mm.	mm.
First phalanx.	Length	70	69
	Width of proximal end	46	50
	Width at distal end	43	45
Second phalanx.	Length	38	38
	Width at proximal end	46	52
	Width at distal end	43	46

THE PELVIC GIRDLE (Fig. 22) differs from that of the Tarpan in its remarkably large dimensions so far as regards its width and height. The length, on the contrary, falls short of that of the Tarpan's pelvis. The broad pelvis of *E. prjevalskii* contains a very strongly developed ilium, which is closely related to its fellow at the inner anterior angle. Of the other peculiarities of the pelvis the remarkably deep but narrow incisura ischiadica must be mentioned. At the same time the width of the ilium on a level with the deepest part of the curve of the incisura is greater than in the Tarpan; this pointing to the circumstance that the pelvic bones of the Prjevalsky horse generally are thicker than those of the Tarpan. The outer surface of the horizontal ramus of the pubis is very uneven. The obturator foramen is smaller than in the Tarpan, and has a more rounded outline. The posterior border of the ischium is thicker than in the Tarpan, but the tuber

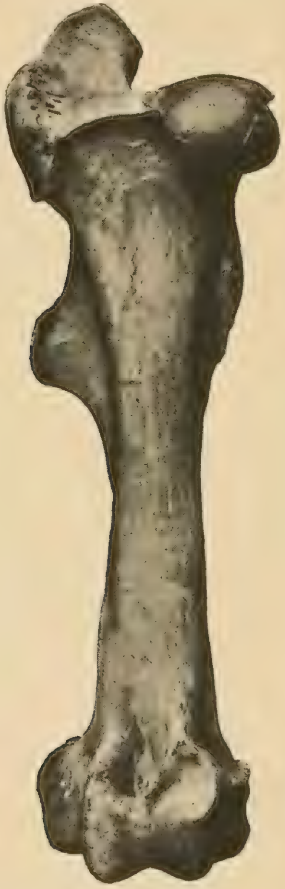

Fig. 23.—Femur.

ischii is not so thick. In the following table the size of the pelvic bones of *E. prjevalskii* and the Tarpan are given :—

	E. prjevalskii.	Tarpan.
	mm.	mm.
Width of the pelvis between the two external anterior angles of the ilia	418	395
Distance from the inner anterior angle of the ilium to the pubis	304	335
Distance between the inner anterior angles of the two ilia ...	7	22
Least width of the ilium on a level with the incisura ischiadica	45	39
Height of the pelvis from a horizontal surface to the tip of the inner anterior angle of the ilium	173	146
Width of the ilium from the inner anterior angle to the outer anterior angle	260	238
Width of the obturator foramen	64	70
Length of the obturator foramen	42	45

THE FEMUR (Fig. 23), like the humerus, is thicker than the corresponding bone of the Tarpan. It is especially strong in its distal part. Its length is less, and its width at the distal end is about 4 cm. greater than in the femur of the Tarpan ; although the proximal end is narrower than in this animal. So far as the shape of the femur of the Prjevalsky horse is concerned, it presents nothing striking ; except the somewhat strong development of the head (caput femoris) and the relatively large size of the trochanter medius :—

	E. prjevalskii.	Tarpan.
	mm.	mm.
Greatest length of the femur	373	378
Length from the caput femoris	337	348
Width on a level with the caput femoris	109	111
Width at the distal articular surface	81	81
Width at the condylus internus	118	114

THE TIBIA.—Of the bones of the leg, the tibia alone is available ; the fibula is missing. A comparison of the tibia of *E. prjevalskii* with the same bone of the Tarpan leads to the same results as in the bones already described. In the Prjevalsky horse the bone is wider and more massive, as well as shorter ; and all its elevations and depressions are more pronounced. The differences between the tibia of *E. prjevalskii* and of the Tarpan are here shown :—

	E. prjevalskii.	Tarpan.
	mm.	mm.
Length of tibia on the anterior side	304	311
Greatest length	325	333
Length on the outer side...	300	307
Width of the proximal end	92	90
Width of the distal end	65	65
Width of the distal articular surface	48	44

CALCANEUM AND ASTRAGALUS.—These have almost precisely the same dimensions as have the same bones of the Tarpan. The greatest difference—amounting to 4 mm.—is in the length of the calcaneum. The difference in the size of the other bones does not exceed 3 mm.:—

	E. prjevalskii. mm.	Tarpan. mm.
Greatest length of the calcaneum	100	104
Greatest width of the calcaneum at the sustenaculum tali ...	60	57
Greatest diagonal length of the trochlea of the astragalus ...	72	70
Width of the articular surface for scaphoid	48	49
Antero-posterior diameter of the articular surface for scaphoid	34	33

THE METATARSUS.—That which has been said for the other bones of the extremity holds good for the metatarsus also. There is a remarkable absence of differences in its dimensions in *E. prjevalskii* and the Tarpan:—

	E. prjevalskii. mm.	Tarpan. mm.
Greatest length of metatarsus	262	256
Anterior length in the middle line	258	252
Length on the outer side	252	244
Width of the proximal end	49	46
Width in the middle of the shaft	31	29
Width of the distal end	47	46
Thickness of the proximal part of the inner rudimentary metatarsal bone (II.)	13	16
Width of the proximal end of the inner rudimentary metatarsal bone (II.)	20	18
Thickness of the proximal end of the outer rudimentary metatarsal bone (IV.)	19	16
Width of the proximal end of the outer rudimentary metatarsal bone (IV.)	23	23

The Geographical Distribution and Habits of Equus Prjevalskii.

From the statements found in the literature upon the distribution of Prjevalsky horse, and from the data accumulated by the capture of those animals which have been transferred to the Zoological Museum, it may be concluded that the horse is an inhabitant of the Dzungaria and Kobdo districts of the Gobi Desert. The skins, skulls and skeletons (Nos. 3,074, 3,091-3,093) received from G. E. and M. E. Grum-Grjimailo were obtained from animals captured, as appears from the report of the expedition,* in the Gashun valleys. In the same report—which contains valuable statements relative to the habits and disposition of the Prjevalsky horse, as well as a fascinating description of the hunting of this animal—are given the approximate limits of its distribution, from the River Atschik-Su eastward to Sydshira. Not far from this district, a considerable number of Prjevalsky horses were captured by D. N. Clemenz. No. 3,089 came from the Dzungarian Gobi, behind the Baityg-Bogdo Mountains, and Nos. 3,087 and 3,088 are likewise from Dzungarian Gobi (between Nursu and Seligendze). Two foals, received from D. N. Clemenz, were killed in the Gobi Desert near the Ebi well, in the neighbourhood of the road leading from Kobdo to Barkul (Nos. 3,072 and 3,073). A stallion (No. 3,094), obtained by the Roborovsky-Kozlov Expedition, was killed near Lake Gutschen. Definite statements regarding the other horses are wanting: these being the specimens added to the Museum by N. M. Prjevalsky (No. 1,523), Schischmareff (No. 3,090, from the Kobdo district) and D. M. Clemenz (No. 3,071, from the River Bulunga).

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* Op. cit. pp. 188-211.

In regard to living specimens, there are only the detached accounts of the animals in the Moscow Zoological Gardens. These were presented to the Gardens by Assanoff and came from the Kobdo district of the Otschiginsk part of the Gobi Desert (48° N., 90° 35′ E.). The horses now at Tsarskoe-Selo, as I gather from a letter of Prince A. A. Oochtomsky, were obtained from the herd of the Van's of Torgoutsk in Western Mongolia.

From the above it is evident that the distribution of *E. prjevalskii*, so far as the present data go, is fairly limited. Taking into consideration that the Prjevalsky horse is found northwards as far as the River Urungu and inhabits the Kobdo Steppe; and that westward its distribution is limited by the Manasu, close by meridian 84° (as evidenced by the statement of Pewtzoff); it may be concluded that its area of distribution is confined to a rectangular district, bounded on the north by 48°, on the south by 46°, on the west by 84° E. and on the east by 90°-91° E.

Of the habits of *E. prjevalskii* comparatively little is known. The brothers Grum-Grjimailo, the only travellers who have had an opportunity of observing the horses in the wild state, give the following account of them: "The wild horse is an inhabitant of the level districts, and goes at night to the pasture-lands and drinking-places. At break of day he returns to the desert, where he rests until sunset. In the Spring, when there are foals in the herd, the animals always rest in the same place. The fact that I found a place of about 1,609 metres square, covered with a thick layer of foals' dung, affords proof of this habit. From the almost entire absence of coarser dung, it may be assumed that the resting-place of the herd is changed as soon as the foals grow up; whereas it is constantly the same so long as the foals are small.

" The wild ass, on the contrary, prefers to lie about the foot of mountains. With the rising of the sun, the herd leaves the mountain for the pasture-lands and drinking-places; and with the setting of the sun, return to the hills where they pass the night. Generally, they prefer hills overgrown with steppe-vegetation; but they also live on desert plateaux. We also met with groups of onager and Dshiggetai, but could not discover the place where they usually spent the night.

" The wild horses generally walk one behind the other, especially when avoiding a danger. The onagers and Dshiggetai, on the contrary, crowd together in herds and flee in disorder when startled. From the habit the horses have of walking in a line behind each other, deeply trodden paths are found in the whole district. In places frequented by the onager and Dshiggetai, on the contrary, there is nothing of this nature, except in the valley of the upper course of the Galjtschshou (Chyi-Cho).

" One of the most certain indications of the presence of the wild horse in a district, is the occurrence of enormous heaps of dung along the paths. From this characteristic, a Mullah remarked that the horses had gone to the drinking-places the day before; and we confirmed the significance of the indication immediately on our arrival at Gashun. In case of danger, the stallion runs forwards only if the herd contains no foals; and even then he often runs to the side and shows by his movements an extraordinary disquiet. The onager, on the contrary, is more of an egoist, and distresses himself little about the danger which threatens his harem and the grown-up generation.

" The onager and Dshiggetai do not neigh, but scream; and that but seldom. The wild horse, on the other hand, neighs clearly, and the neigh corresponds exactly to that of the domestic horse. In the same way, the snorting of a greatly frightened wild horse reminds one of the like noise of our domestic horse.

" The Mongolians have made many efforts to tame the wild horse, but in vain; the horse will not submit to man, is afraid of him, and cannot be rendered serviceable. The capture of the wild horse, as practised by the Mongolians, is a very simple affair. At the time when the mares foal, the Kalmuks betake themselves to the plains with two horses. Having discovered the herd, they follow it until such time as the still weak foals can go no farther. The foals are then taken away and reared in a herd of domestic horses."*

The statement of G. and M. Grum-Grjimailo regarding the failure of all attempts to tame the Prjevalsky horse agrees with what is known of the specimens which have been brought into Russia. These also cannot be tamed. Still there are facts known which indicate that there is yet hope of the horses being tamed. P. K. Kozlov [*] saw a six-month foal, belonging to the Van of Ljukschin, which had been so far tamed as to go well in a bridle, and mount with ease a stairway leading to the second floor, and also to allow the seven or eight year old son of the Van's to sit on its back.

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* Op. cit. pp. 209-211.

The Zoological Position of Equus Prjevalskii.

The appearance of Poliakof's work on *E. prjevalskii* evoked the most contradictory views among West European specialists. At one time, the question of the existence of the wild horse was decided in the negative. The nature of the Tarpan, which still lived in Russia a few decades ago, and which was recognised by many as an European wild horse, was not clear; and, indeed, can still be counted as not settled. Two eminent specialists of hippology, Piétrement and Sanson, arrived at the conclusion that the wild horse had become extinct in prehistoric times: they, therefore, received Poliakof's discovery with distrust. Piétrement opposed the inclusion of the Prjevalsky horse in the same species of *Equus* to which *E. caballus* belongs; and did so on the grounds that the root of the tail of the wild horse is covered with short hair, a peculiarity indicating an affinity to the onager. The doubt as to the position of the Prjevalsky horse as a separate species of *Equus* was called forth because (1) this species was founded on one single specimen, and (2) the specimen was not full-grown. Flower [†] said: "Until more specimens are obtained it is difficult to form a definite opinion as to the validity of the species, or to resist the suspicion that it may not be an accidental hybrid between the kiang and the horse." A similar opinion was held by Hahn.[‡] On the other hand, Tegetmeier and Sutherland [§] held that such a suspicion need not be entertained, since hybrids between two species seldom occur without human interference.

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[*] Труды экспедиціи Императорскаго Русск. Географ. Общества по центральной Азіи, совершенной въ 1893–1895 гг. подъ начальствомъ В. И. Роборовскаго. Часть II. 1899.

[†] Flower. *The Horse* (Modern Science series. Edited by Sir John Lubbock). 1891. p. 79.

[‡] Hahn. *Die Hausthiere und ihre Beziehungen zur Wirthschaft des Menschen.*

[§] Tegetmeier and Sutherland. *Horses, Asses, Zebras, Mules and Mule Breeding.* 1894.

At the present time, Flower's objections fall to the ground, inasmuch as we now possess over ten skins and about ten skulls of *E. prjevalskii*, from which it is easy to demonstrate the constancy of the characteristics of the species.

The external characters, as already given, lead to the conclusion that the most important among them and those which are to be considered as constant are: The considerable size of the head; the absence of a fore-lock; the upright mane; the dorsal and shoulder stripes; the characteristic form of the tail, which carries some of the features of the tail of the onager; the size of the ear (smaller than that of the ass and the onager); the colour of the trunk; the colouration of the lower part of the limbs; and the striping of the limbs. Other, and less important, features, such as certain differences of colouration, are to be regarded as individual variations. Craniological and craniometric investigations, as well as the examination of the skeleton, lead to the conviction that *E. prjevalskii* represents a special and peculiar form of horse which constitutes a separate species or race—the exact term matters not: (Matschie designated all the forms commonly received as species of the genus *Equus* as "local races"* of *Equus* standing in close affinity to *E. caballus*).

The constancy of the structural features and their characters, but mainly the area of geographical distribution of *E. prjevalskii*, indicates that it is really a wild species of horse, and not a hybrid between the kiang and the domestic horse, as some zoologists have supposed. If the hypothesis that it is a hybrid were correct, how comes it that the Prjevalsky horse is not met with everywhere where the kiang dwells? As is well known, the kiang has a much wider distribution than has the wild horse. Moreover, the Prjevalsky horse lives in herds in which mares with foals are found. This is not compatible with the infertility of the hybrid of the ass and the horse.

From the above, it follows that *E. prjevalskii* is a separate form—species or race—of the genus *Equus;* equivalent to the other species or races, such as the kiang, the onager, the ass, &c. The species is of extraordinary interest, since, in it, the characters of the domestic horse (presence of callosities on all four limbs) are mixed with features reminding one of the Asiatic ass (mane, form of tail). These characters, and especially the form of the tail, do not agree perfectly with the like features in the ass, but form something intermediate between the characters of the horse and those of the ass. The tail has more resemblance to that of the horse; but it is distinguished by its basal (root) part being clothed, for a little distance from the root, by hairs which are coarser and shorter than those on the distal part. These hairs, nevertheless, are much longer than the corresponding hairs of the wild ass, and, moreover, are closer together; therefore, the shape of the tail as a whole reminds one much more of the horse than of the ass. A tail, similar to that of *E. prjevalskii*, may often be observed among domestic horses, in which the proximal part is frequently covered with short, stiff hairs.

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* Op. cit. p. 208.

In the comparison of the Prjevalsky horse with other horses, the consideration of the Tarpan naturally takes a premier place. Concerning the Tarpan, as yet only somewhat scanty and often contradictory statements have been made.[*] The first information regarding this animal is found in Gmelin's account of his journey through Russia,[†] during which he had an opportunity of observing these animals at Bobrow (Woronetz). According to his description, the Tarpan is a small, mouse-coloured horse, with a short and curly mane,[‡] and with the limbs, from the knee to the hoof, coloured black. The head, he says, is immensely thick. Other particulars, such as those relating to the ears and tail, are very indefinite. The ears are now short, as in the domestic horse; now long, as in the ass, and hanging down. The tail is sometimes compact, sometimes scanty; but always shorter than in the horse. I cannot enter here into a fuller discussion of the other descriptions of the Tarpan which have been framed from the accounts of people who have been able to observe the animal in a state of freedom (statements relative thereto are collected together in Köppen's paper), but will turn to the protocol drawn up on the inspection of the Tarpan delivered at the Moscow Zoological Gardens by I. N. Schatiloff on the 30th August, 1884. This Tarpan was captured in 1866, when a small foal, on the Zagradoff Steppe of Prince Kotschubei. It was brought up by a mare, castrated, and, when eighteen years old, brought to Moscow. The protocol, signed by the Vice-Presidents and members of the Moscow Society of Acclimatisation, is a valuable document relative to the description of the Tarpan, and is printed in the paper by I. N. Schatiloff.* From it we learn some features of the Tarpan which were not discussed by the earlier authors; among others, that it has a fore-lock and that its hind limbs possess no callosities. This Tarpan was mouse-coloured, and the limbs from the tarsus downwards were very dark, almost black, in colour. Both these characters agree with Gmelin's statements. But in regard to the length of the mane (a very important feature) the protocol differs somewhat essentially from Gmelin's description. According to Gmelin, the mane in the animals observed by him was very short and curly. In the Tarpan of the Moscow Zoological Gardens, on the contrary, its length was 48 cm. and it hung down over the left side of the neck. Unfortunately, the tail was not sufficiently investigated. Its form, and the arrangement of the hair, are not clearly distinguishable in the photograph given in I. N. Schatiloff's paper. This is unfortunate, as these points would be of special interest in the comparison with the Prjevalsky horse.

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[*] A full review of the literature on the Tarpan will be found in the papers by Th. P. Köppen (Къ исторіи тарпана въ Россіи. Журналъ министерства народнаго просвѣщенія. 1896. Январь), and D. N. Anutschin (Къ вопросу о дикихъ лошадяхъ въ Россіи. (Журн. Министерства Нар. Просв. 1886, Іюнь, Іюль).)

[†] Gmelin. *Reise durch Russland zur untersuchung der drei Naturreiche.*

[‡] According to Pallas (*Zoographia Rosso-Asiatica*, Vol. I., p. 260) the mane in the Tarpan is "sub-erecta."

There are two skeletons of the Tarpan in existence.† One of them is in the Zoological Museum of the Academy of Science, and belongs to an animal presented by I. N. Schatiloff in 1862. The animal was not then recognised as a Tarpan, but its skeleton was nevertheless preserved, and examined for the first time by Czerski. In my tables of the dimensions of the skull, as well as in those of the measurements of the shoulder and pelvic girdles and the bones of the extremities, I give the size of such of the bones of this skeleton as are of interest in comparison with the corresponding bones of *E. prjevalskii*. The second skeleton is in the Zoological Museum of the University of Moscow.

From craniometric observations, Czerski came to the conclusion that the Tarpan possesses all the characters of the group of Oriental horses, and unites the Arab, on the one hand, with the Celtic race (to which the pony belongs) on the other. The Tarpan whose skull and skeleton are in the Zoological Museum of the Academy of Science, stands in very close craniometric relationship to *E. prjevalskii;* although the skull does not accord with any of the skulls of adult examples of this species. Some Asiatic horses agree, in their absolute measurements, more closely with certain specimens of the Prjevalsky horse (for example, the horse from the River Adytsch district and No. 3,094 of *E. prjevalskii*). But when the average dimensions are expressed as indices the resemblance between the two horses is more striking. This is particularly strong when the bones of the extremities and the shoulder and pelvic girdles are compared. The resemblance may depend upon the similarity in size of the two animals. Naturally, it is very difficult to come to any conclusion so long as there is only a single skeleton of the Tarpan available for comparison. At all events, the bones of *E. prjevalskii* are distinguishable from those of the Tarpan on account of their considerable bulk, their width in comparison with their length, and their very pronounced eminences. The number of lumbar vertebræ is the same in the Prjevalsky horse and the Tarpan: both possess five. But great significance cannot be attached to this feature, which is generally held to be characteristic of the ass; for other races of the horse have five vertebræ, while it is alleged that the ass sometimes has six.

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* І. Н. Шатиловъ. Сообщеніе о тарпанахъ. Москва, 1884.

† In a short paper, entitled *Wilde Pferde im Park des Herrn Falz-Fein in Ascania Nova (Südrussland)*, which appeared in the *Illustrirten Zeitung* for 1901 (No. 3010). Matschie makes some statements regarding the Tarpan. Of the animal belonging to the Academy of Science he says: "Unfortunately the Russian zoologists could not convince themselves that they had to do with a wild horse, but considered it to be a Steppe horse which had run wild, and presented it to a friend. In this way the only representative of the Russian wild horse which could be examined by scientists was lost to science. No skin, skull or skeleton of the Tarpan is to be found in any museum in the world, &c." As remarked above, at the present time there are two skeletons of the Tarpan, one in Moscow, the other in St. Petersburg. The St. Petersburg skeleton, together with the skull and the Moscow skull, were described by Czerski in his excellent monograph, which I have cited above, and in which are found all the statements regarding the Tarpan. It is strange that Matschie made no use of the material contained in Czerski's monograph (which must certainly have been known to him), but instead made quite incorrect assertions without naming his authorities.

External characters play a very important part in the comparison of the Prjevalsky horse and the Tarpan. The most important of these is the black colouration of the limbs from the knee to the hoof. This is very constant in *E. prjevalskii* and distinguishes it from the Asiatic wild ass, in which the lower part of the limb is always light-coloured or even quite white. Another not unimportant character in the Prjevalsky horse is the striping of the limbs, which, although also occasionally found in the domestic horse (*cf.* Darwin's "Variation of Animals and Plants under Domestication"), serves as a broad distinguishing character for *E. prjevalskii*, even if it is one not absolutely constant. The dorsal stripe constitutes a much more constant feature; although this also cannot be accounted a character which would place the Prjevalsky horse and the Tarpan close to the Asiatic ass and the African ass. In domestic horses of certain colours—mouse-fawn, dun and especially light-coloured horses—there is almost always a dorsal stripe; while in some Asiatic asses *(E. hamár*, H. Sm) it is absent. At all events, the constancy of this character justifies one in regarding it as a feature possessed by the common ancestor of the ass and the horse.

Parallel with fairly material points of similarity, exist essential differences between the Prjevalsky horse and the Tarpan; such are, the presence of a fore-lock in the Tarpan, the longer mane (*vide* the Commission which examined the Crimean Tarpan) in this animal, and the presence of a tail which in some ways resembles that of the domestic horse. All these characters indicate that the Tarpan is a form more specialised in the direction of the horse than is *E. prjevalskii.* The examination of the Crimean specimen certainly showed that the most essential feature of distinction between the horse and the ass—the callosities of the posterior limbs—is wanting in the Tarpan. On this point, however, one cannot regard finality as having been reached; firstly, because only one specimen of the Tarpan has been investigated; and, secondly, because in certain races of the horse the callosities are absent and yet there are all the other characters of the horse and none of the ass.

The Prjevalsky horse represents a generalised form intermediate between the horse and the ass; and this leads to the assumption that it is more closely allied to the common stem-form of the horse and the Asiatic ass than is any other species of *Equus.* Herein rests the great importance of *E. prjevalskii.* In what genetic relationship does it stand to the domestic horse? Has it given origin to any of the ancestors of the domestic horse? Had it, in the past, a wider geographical distribution than it has to-day? These questions cannot be answered definitely, for, at the present time, we have only very little actual foundation upon which to base the answers.

ADDENDUM.

When my paper was already in the press, two communications by Professor Noack *(Equus Przevalskii* and *Die Entwickelung des Schädels von Equus Przevalskii)* appeared in the *Zoologischer Anzeiger* (Nos. 663 and 664). Both articles are founded upon the study partly of living material and partly of material in the form of skins and skeletons obtained from Herr Hagenbeck of Hamburg. I am very glad that Noack also has observed the shoulder stripe, which I reported at the Natural History Congress held in St. Petersburg (see " Report of this Congress," p. 194), and in my article in the *St. Petersburgskija Wjedomosti.* The occurrence of shoulder stripes, exceedingly interesting features of the Prjevalsky horse, can no longer be doubted.

The resemblance of *E. prjevalskii* to any of the varieties of the domestic horse is still open to question, since the material for making such a comparison, by which alone the question could be settled, is yet insufficient in amount. It is very possible that the Prjevalsky horse has an affinity to the pony, still it is my opinion that it is yet too early to regard the resemblance, with Noack, as "irrefutably proved." At any rate, *E. prjevalskii* possesses so large a number of characters which were probably peculiar to the common ancestor of the horse and the ass, and which are still present in the ass (formation of the tail, shoulder stripe, character of the mane, absence of the fore-lock), that we must take for granted a form intermediate between the Prjevalsky horse and the domestic horse. It is quite possible that such a transition form occurs among fossil horses, to which, according to Noack, *E. prjevalskii* has much resemblance.

To Professor Noack's assertion that "thanks to the negligence of Russian zoologists no skin and no skeleton (of Tarpan) exists," I can make the same rejoinder that I have already given to Matschie. A skeleton of the Tarpan is in existence, and has been measured and described by J. D. Czerski in his monograph, *Ueber die posttertiären Saugethiere Sibiriens*, which, though well known in Russia, is unfortunately still unknown to both Matschie and Noack.

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TABLE OF MEASUREMENTS OF THE SKULLS OF DIFFERENT SPECIES OF EQUUS

	[illegible]									EQUUS HEMIONUS, PALL.																
	YOUNG.				ADULT.					YOUNG.										ADULT.						
[illegible]	[illegible]	[illegible]	186	185	201	202	208	209	212	178	133	179	191	149	190	185	180	197	180	197	197	198	202	204	209	196
[illegible]	[illegible]	[illegible]	181	190	202	197	201	198	202	164	131	173	172	140	178	172	171	197	178	187	190	183	193	195	197	196
[illegible]	[illegible]	[illegible]	361	356	385	378	382	392	387	312	246	331	345	266	345	346	339	372	349	351	357	355	387	382	375	371
[illegible] of upper cheek-teeth	—				178	178	185	170	183	—	—	—	—	—	—	—				150	160	179	164	173	165	174
Length of the series of lower cheek-teeth	—	—	—	—	174	178	185	167	186		—	—	—	—	—					153	160	178	170	171	165	
[illegible]e from the margin of the foramen magnum to the vomer	97	107	111	118	118	125	117	123	119	94	82*	98	95	84	—	113*	106*	108	—	95	105	105	116*	106	115*	111
[illegible] from the vomer to the palatine bone	76	95	101	95	105	110	110	109	105	98	73	101	105	86	—	105	105	120	—	122	112	113	110	120	103	128
[illegible] width of upper jaw (width of muzzle)	48	62	69	65	73	71	72	71	76	53	41	59	61	41	72	52	66	64	53	53	66	62	67	65	65	67
[illegible]ponding width of lower jaw	47	54	66	56	68	67	70	63	68	49	36	51	59	39	50	50	52	59	50	49	54	55	56	48	58	63
[illegible] of lower jaw	316	365	392	389	430	421	434	436	426	353	265		251	233	384	380	364	405	384	383	399	400	420	418	435	416
[illegible] of diastema from incisors to premolars in the upper jaw	56	80	87	88	87	79	77	90	88	78	—	67	72	50	81	80	71	88	81	86	73	66	83	84	95	78
[illegible] width of cranium	89·5	84	93	99	90	84	87	94	91	82	78	75	81	81	86	81	80	84	84	73	77	72	75	77	78	75
[illegible]ht of occipital bone measured from lower margin of foramen magnum	86	89	97	99	102	111	105	110	105	88	75	83	94	—	92	88	95	98		93	97	89	95	97	103	100
[illegible] of face measured from M_3 to middle of inter-[illegible] suture	—		—	—	133	135	139	137	138	—	—	—	—	—	—	—	—	—	—	121	124	132	143	139	139	112
[illegible] IV	[illegible]		174	178	175	179·7	174	177·4	175	162	197	193	184	182·7	191·6	183·8	182·4	176·7	182·7	187	187	180	178	179	181	171
	200·4	212·6	220	207	225	211	215	227	212	205	192	200	195	195	197	204	200·7	220	195	208	200	212	216	211·6	209	215·5
W[illegible]or part	88	98	98	104		—	—	—	108	93	72	91	98	78	103	112	95	—	104	—		104	—	-		—
W[illegible] length	84	92	93	93			—	—	106	88	72	95	98	72	97	108	102	--	108	—	—	100	—		—	-
W[illegible]rior part	15	17	52	54	—	—			53	48	36	45	46	38	48	54	45		54		—	55		—	—	—
[illegible]ghest point of the [illegible]frontal suture	173	220	222	230	—	—			255	184	145	228	218	177	228	218	218	—	240	—		211	-	—	—	—
[illegible] of nasal bones along the inter-nasal suture	150	186	200	204	—	—		—	210	169	123	186	178	152	184	196	185		196	--	—	209	—	—	—	-

	EQUUS HEMIONUS, VAR. KIANG, MOORCR.											EQUUS ASINUS, L.				[illegible]	[illegible]
	YOUNG.									ADULT.		YOUNG		ADULT			
[illegible]	121	195	211	122	130	—	120	119	198	218	202	171	154	167	176	209	176
[illegible]	127	186	191	121	186	114	117	117	193	198	195	182	159	164	175	[illegible]	171
[illegible]	214	352	378	205	[illegible]	196	214	210	370	389	363	287	262	277	286	375	342
[illegible] of upper cheek-teeth										168	165		—	130	144	163	159
Length of the series of lower cheek-teeth										167	160			132	144	162	160
[illegible]e from the margin of the foramen magnum to the vomer	73*	105	109	79*	110	79*	72*	77*	107	110	113*	89	83	87	86	108	107
[illegible] from the vomer to the palatine bone	70	115	124	73	117	59	72	63	120	128	107	98	86	93	96	120	102
[illegible] width of upper jaw (width of muzzle)	38	60	67	42	53	—		-	64	78	67	52	47	55	50	66	61
[illegible]ponding width of lower jaw		50	61	39	58	—				63	61	45	41	45	43	55	51
[illegible] of lower jaw	216	398	407	238	412	230	242	237	—	421	400	336	305	318	328	412	386
[illegible] of diastema from incisors to premolars in the upper jaw	—	92	89	—	86		—	--	87	93	84	70	62	70	62	90	74
[illegible] width of cranium	71	80	76	75	75	78	80	79	85	72	81	70	66	70	71	84	73
[illegible]ht of occipital bone measured from lower margin of foramen magnum	71	97	94	72	96	67	72	71	98	81	98	84	80	81	88	100	90
[illegible] of face measured from M_3 to middle of inter-[illegible] suture	—	—	136	—	—	—	—	—		147	139	111	—	102	103	130	125
[illegible] IV	174											176·5	187	174·5	186·8	183	
	200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		194	208	218	203·9	204	[illegible]
W[illegible]or part	—	—	—	—	-	65	67	68	—	—	—		70	80	—	108	98
W[illegible] length	—	—	—	—	—	64	65	70	—	—	—	—	75	85		107	100
W[illegible]rior part	—	—	—	—	—	31	29	30	—	-	-		38	38	—	53·5	52
[illegible]ghest point of the [illegible]frontal suture	—	—	—			120	140	140	—	—	—	—	159	179	—	218	246
[illegible] of nasal bones along the inter-nasal suture	—	—	—	—	—	106	105	114	—	·	—	—	149	169	—	195	197

	YOUNG.		[illegible]																		
[illegible]	185	156	215	195	205	201	203	212	206	216	205	201	216	226	202	216	199	187	201	202	184
[illegible]	173	158	192	208	196	200	190	209	203	205	195	190	208	207	189	—	211	210	199	189	183
[illegible]	339	301	370	370	383	368	348	393	379	381	365	374	367	361	364		434	385	[illegible]	358	367
[illegible] of upper cheek-teeth			170	160	171	173	172	162	175	178	176	171	160	171	162	170	176	172	146	154	—
Length of the series of lower cheek-teeth	—		175	152	174	177	176	164	178			178	161		172	183	170	168	145	-	-
[illegible]e from the margin of the foramen magnum to the vomer	109	110	112	131	127	121	114	126	126	114	124	115	132	117	126	131	123	119*	112*	106	[illegible]
[illegible] from the vomer to the palatine bone	91	82	103	105	101	99	100	108	103		102	100	97	101	98	107	133	111	103	109	112
[illegible] width of upper jaw (width of muzzle)	61	52	[illegible]	[illegible]	71	77	61	70	70	68	62	72	68	75	69	77	70	69	63	69	70
[illegible]ponding width of lower jaw	—	47	63	73	65	58	61	61	57		—	66	53	—	57		60	58	50	48	-
[illegible] of lower jaw	385	330	409	434	424	412	393	425	427	-		430	415		—	410	470	430	382	402	407
[illegible] of diastema from incisors to premolars in the upper jaw	76	—	106	108	98	84	88	100	95	104	80	90	97	93	91	98	116	100	78	93	94
[illegible] width of cranium	87	100	82	78	77	71	82	79	80	77	79	84	82	80							
[illegible]ht of occipital bone measured from lower margin of foramen magnum	86	90	91	120	100	117	93	106	96	88	99	96	93	105	98	-	110	96	98	115	105
[illegible] of face measured from M_3 to middle of inter-[illegible] suture		93	134	130	130	130	126	146	127	150	125	134	—	144	125	140	146	143			
[illegible] IV	177·4		180	180	172	180	172	175	181·6	175·6	174·6	180·4									
	215		214	213	234	210	211	222	213	219	217	213									
W[illegible]or part	98	90	-	-	—	—	—		—		—			—	—	—					
W[illegible] length	90	90		—	—	-	·	—							—			-			
W[illegible]rior part	44	44	—	—		-	-	—	—	—	-			-	—			-			
[illegible]ghest point of the [illegible]frontal suture	199	182	—			-	·	—			—	-	-	—	—	—		—			
[illegible] of nasal bones along the inter-nasal suture	174	154	—	·	—	—	—	—	—	—	—	-		—	-		—	—			

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